West Valley Demonstration Project

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GROUNDWATER MONITORING PLAN

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1.0 INTRODUCTION

1.1 RCRA Considerations

This document is included with other documents in the 6 NYCRR 373-2 Hazardous Waste Operating Permit (i.e., RCRA Part B Permit) application. Proposed revisions to this document shall be reviewed by the Environmental Affairs Department of the West Valley Nuclear Services Company (WVNSCO) to determine the potential effect on the permit application and subsequently approve or disapprove the revisions to this document.

1.2 Program Overview

The Groundwater Monitoring Plan (GMP) provides information on the groundwater monitoring program at the West Valley Demonstration Project (WVDP). This plan is based on long-term monitoring requirements as delineated in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) reports and meets environmental protection requirements specified in United States Department of Energy (DOE) Order 450.1. The GMP was implemented beginning with the first-quarter 1996 groundwater sampling round and will, at a minimum, be reviewed annually and updated every three years. Any changes involving RCRA groundwater monitoring wells or parameters will be coordinated with the New York State Department of Environmental Conservation (NYSDEC) prior to implementation.

The GMP is based upon guidance for groundwater monitoring of solid-waste management units (SWMUs) as provided by U.S. Environmental Protection Agency (EPA) technical documentation (e.g., *Groundwater Monitoring Technical Enforcement Guidance Document* [TEGD] [September 1986]). WVDP internal documentation such as WVDP-209, Environmental Monitoring Program Procedures, and WVDP-214, URS Environmental Monitoring Procedures, provide specific controls that ensure the adequacy of collected data. Appendix A contains a list of procedures relevant to this GMP.

1.3 Program Objectives

Groundwater monitoring program objectives focus on conformance with applicable New York State (NYS) and EPA regulations, DOE requirements, and West Valley Nuclear Service Company (WVNSCO) corporate policy and emphasize protection of the environment both during and as a result of operations. The GMP establishes the overall framework for characterizing any existing groundwater contamination; monitor present conditions; and supporting potential mitigative and long-term monitoring requirements. The WVDP's strategy for achieving the groundwater monitoring program objectives includes implementing a detection monitoring program as described below and in section 3.0.

The groundwater monitoring program has been developed to provide the tools and implementing structures to achieve the following objectives:

- The WVDP will continue to refine its understanding of the hydrogeologic characteristics of the site using data generated from ongoing monitoring activities.

- The WVDP will assess groundwater quality via groundwater sampling to determine when modification of the current groundwater monitoring program is necessary and increase awareness of the effects, if any, that past or present activities have made on this resource. Groundwater monitoring provides the data necessary to identify and delineate (both horizontally and vertically) groundwater contamination attributable to site activities, facilitate and expedite necessary mitigative efforts, if required, and satisfy regulatory and other DOE requirements for site activities.

- The WVDP will conduct its groundwater monitoring program to determine and document the effects of operations on groundwater quality, demonstrate compliance with DOE requirements, and support RCRA Facility Investigation (RFI) activities related to the RCRA 3008(h) Administrative Order on Consent. The program will also support strategies for controlling identified contamination and Project-completion goals.

- The groundwater monitoring program will support the WVDP's commitment to keep the general public informed of environmental activities. The WVDP Community Relations Plan (CRP) details activities to provide an open, interactive communication between the public and the WVDP. Aspects of the WVDP groundwater monitoring program that are of interest to the public are presented using various media detailed in the WVDP CRP.

1.4 Site History

In 1959 New York State created an Office of Atomic Development (OAD) in response to strong encouragement by the federal government to commercialize the entire nuclear fuel cycle. The OAD participated in negotiations with the United States Atomic Energy Commission (AEC) and Davison Chemical Company toward a joint venture for development of spent fuel (used nuclear reactor fuel) reprocessing and related facilities. As negotiations progressed, Davison established Nuclear Fuel Services, Inc. (NFS). Davison was then acquired by W.R. Grace & Co., who obtained ownership of NFS.

In 1961 the OAD acquired the land that is now the Western New York Nuclear Services Center (WNYNSC) (Fig. 1). In 1962, New York State law established the New York Atomic Research and Development Authority (NYARDA), a state public-benefit corporation. Title to the WNYNSC was transferred to NYARDA in 1962. (NYARDA became the New York State Energy Research and Development Authority [NYSERDA] in 1975). In 1963, a series of agreements involving the AEC (part of which later became the U.S. Nuclear Regulatory Commission [NRC]), NFS, and NYARDA established the venture at the WNYNSC for spent fuel reprocessing and radioactive waste management.

Construction of the reprocessing facility began in 1963 and was completed in 1966, at which time NFS began operating the reprocessing plant and related radioactive waste management facilities. NFS shut the plant down in 1972 for various expansions and modifications but never resumed reprocessing operations. In 1976, while the plant was shut down, New York State was informed that NFS intended to leave the reprocessing business and not renew the lease when its initial term expired. During the six years of operation, the plant processed approximately 640 metric tons of spent nuclear fuel and generated about 600,000 gallons of high-level radioactive liquid waste (HLW), which was stored in underground tanks at the site.

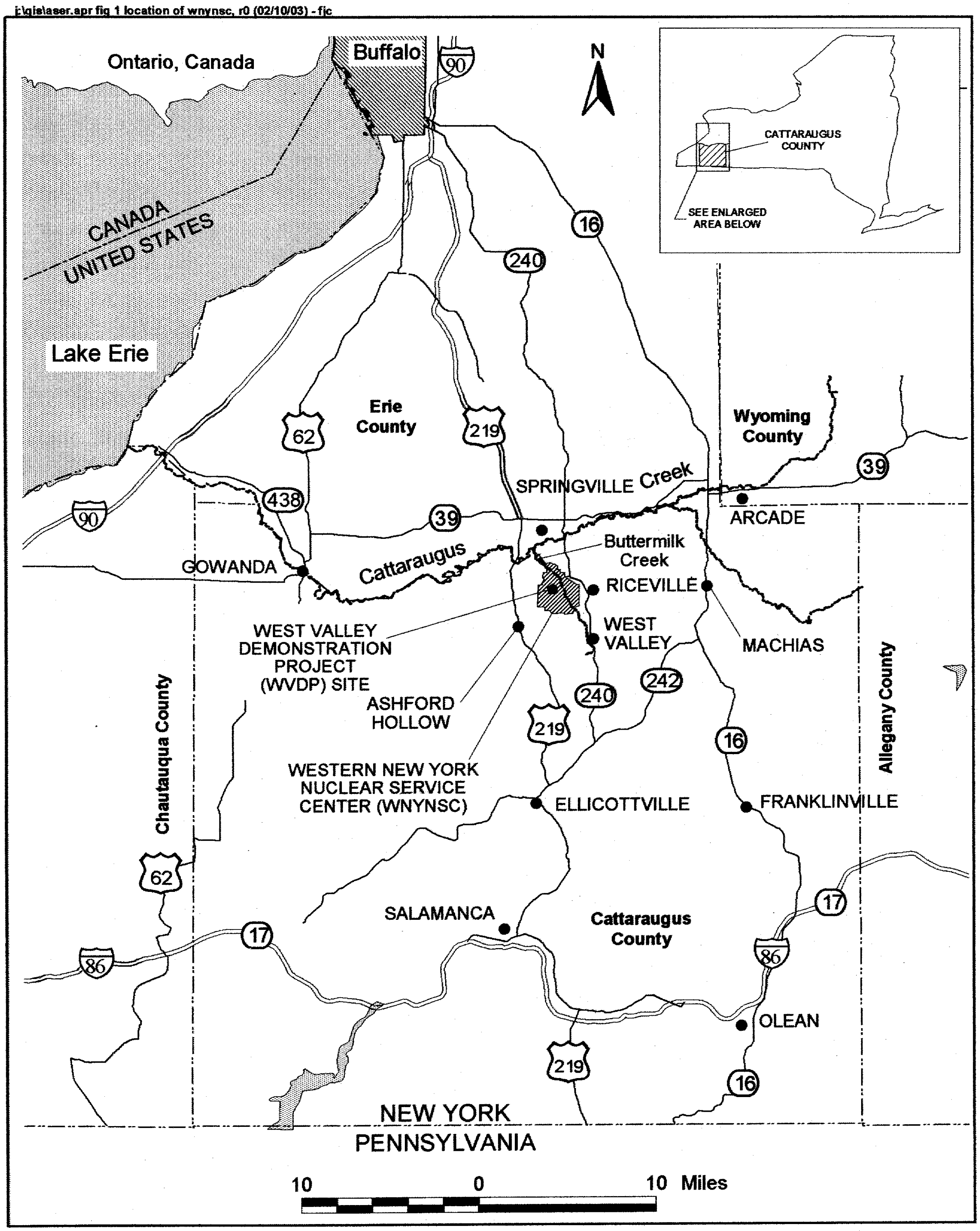
In 1980 the WVDP Act, Public Law 96-368 (U.S. Congress, October 1980), was enacted. It directed the U.S. DOE to demonstrate a HLW management program at the WNYNSC. The objectives of the WVDP are to solidify the liquid HLW, transport containers to a federal repository, dispose of low-level radioactive waste and transuranic (TRU) waste, and decontaminate and decommission the facilities, material, and hardware used to reach those objectives.

Environmental compliance at the WVDP is prescribed by DOE Orders and the Administrative Order on Consent issued in 1992 by the United States Environmental Protection Agency (EPA), Region II, for the WNYNSC (Docket No. II RCRA 3008(h)-92-0202). The Consent Order is administered by the New York State Department of Environmental Conservation (NYSDEC).

The National Environmental Policy Act (NEPA) requires preparation of an environmental impact statement (EIS) for major federal activities such as closure of the WVDP. The DOE is currently preparing an EIS for the WVDP: the Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center EIS. A second draft EIS for Waste Management was issued in May 2003 for public comment. Its scope is limited to onsite and offsite waste management actions. DOE considered public comments and issued the final Waste Management EIS in January 2004. On June 16, 2005, the Record of Decision (ROD) for the Waste Management EIS was published in the Federal Register. A Federal Register Notice of Intent (NOI) was published in March 2003, announcing the DOE’s intent to prepare, in cooperation with NYSERDA, the Decommissioning and/or Long-Term Stewardship EIS. Work on the preparation of this document is underway.

The HLW has been vitrified into a solid glass form and placed into 275 stainless steel canisters that currently are stored onsite. The canisters will be transferred to a federal geologic repository, when available, for permanent storage/disposal. Final site decommissioning activities will not be completed until the canisters are transported offsite.

FIGURE 1. LOCATION OF WESTERN NEW YORK NUCLEAR SERVICE CENTER



2.0 ENVIRONMENTAL SETTING

Extensive environmental information has been compiled that details the specifics of the topography, geology, groundwater and surface water hydrology, geochemistry, and water quality in the vicinity of the WNYNSC. *(See Environmental Information Documents Volume V, III, and I*, [West Valley Nuclear Services, December 1992; January 1993; and April 1993]). The following sections provide a brief summary of the important geological and hydrological factors that directly influence the groundwater monitoring program objectives at the WVDP.

2.1 Site Features

The WVDP site, located about 50 kilometers (30 miles) south of Buffalo, New York, occupies about 89 hectares (220 acres) within the larger 1,354-hectare (3,345-acre) restricted-access WNYNSC. (See Fig. 1.) Management of the WNYNSC is conducted by both the DOE and NYSERDA. The DOE controls the WVDP premises and has operational control over the bulk storage warehouse, a personnel training facility (referred to as the "schoolhouse"), and two reservoirs used for on-site drinking water, all of which lie outside the WVDP premises but within the WNYNSC. NYSERDA manages the remainder of the WNYNSC. Interagency protocol for operating respective portions of the property is contained in a Cooperative Agreement (October 1980) as directed by the WVDP Act.

The WVDP is divided geographically into two sections, the north plateau and the south plateau. The north plateau is situated north of Erdman Brook, and it contains the majority of the plant facilities. Major features of importance to the groundwater monitoring network on the north plateau include the process building, the low-level waste treatment facility (LLWTF) and lagoons; the waste tank farm; the LAG storage areas; the maintenance shop leachfield; and the construction and demolition debris landfill (CDDL). Installation of a temporary treatment system to treat groundwater having elevated levels of gross beta became operational in November 1995. The extent of the gross beta plume is described in the *Subsurface Probing Investigation on the North Plateau* (West Valley Nuclear Services, May 1995b) and in the quarterly groundwater monitoring reports. Results of additional plume characterization work is presented in WVDP-298, *1997 Geoprobe Investigation on the North Plateau at the West Valley Demonstration Project* (West Valley Nuclear Services, January 1998) and WVDP-346, *1998 Geoprobe Investigation in the Core Area of the North Plateau Groundwater Plume* (West Valley Nuclear Services, June 1999).

WVDP property located south of Erdman Brook is referred to as the south plateau. Major features of importance to the groundwater monitoring network on the south plateau include the inactive NRC-licensed Disposal Area (NDA); the inactive New York State-licensed Disposal Area (SDA); and the radwaste treatment system (RTS) drum cell. The SDA, which is not a WVDP facility, is maintained by NYSERDA.

During 1990, the WVDP installed a 240-meter (800-ft) long groundwater interceptor trench along the northern and eastern boundaries of the NDA between Erdman Brook and Lagoon Road Creek, respectively. The interceptor trench was installed to collect potentially contaminated groundwater that may migrate from the NDA through the weathered till. A liquid pretreatment system (LPS) is located near the NDA to process contaminated liquid extracted from the trench. The LPS is designed to ensure conformance to State Pollutant Discharge Elimination System

(SPDES) requirements at outfall 001. No chemical contamination requiring pretreatment has been detected since the LPS became operational in 1991.

2.2 Geologic Setting

The WVDP is located on the dissected and glaciated Allegheny Plateau and is underlain by a thick sequence of Holocene and Pleistocene sediments deposited in a steep-sided bedrock valley. The unconsolidated deposits consist of an alluvial/glaciofluvial silty, coarse-grained unit predominately underlying the north plateau and an underlying sequence of up to three fine-grained glacial tills of Lavery, Kent, and Olean ages, which are separated by stratified, interstadial, fluvio-lacustrine deposits. These fluvio-lacustrine sediments are underlain by the upper Devonian shales and interbedded siltstones of the Canadaway and Conneaut Groups. The uppermost portion of these bedrock units is weathered and fractured, allowing groundwater flow. These strata generally dip southward at about 5m/km (Rickard 1975).

Different stratigraphy is encountered on the north and south plateaus. On the north plateau, the stratigraphy in descending order is as follows: the alluvial/fluvial sand and gravel unit, Lavery till (silty clays), the Kent recessional sequence (kame-delta and lacustrine deposits), the Kent till (silty clays), and shale bedrock. The Lavery till below the north plateau also contains the Lavery till-sand, a lenticular unit of limited extent that is not continuous within the subsurface. On the south plateau the stratigraphy is as follows in descending order: the weathered Lavery till, the unweathered Lavery till, the Kent recessional sequence, the Kent till, and bedrock. The weathered Lavery till is an extensively weathered and fractured zone commonly extending to depths up to 5 meters (15 feet) from grade, where the till becomes unweathered.

2.3 Hydrogeological Setting

The entire WVDP site is located wholly within the drainage basin of Cattaraugus Creek. The creek is located north of the site and flows westward to Lake Erie. (See Fig. 1.) This creek is used for swimming, canoeing, and fishing and provides limited irrigation for a golf course and several tree farms. No public water supply is drawn from Cattaraugus Creek downstream of the WNYNSC.

The WVDP site area is underlain by the silty and clayey Lavery till, a glacial till with low hydraulic conductivity (usually less than 10^{-7} cm/sec), except where near-surface exposure has caused enough weathering and desiccation cracking to develop an extensive and closely spaced fracture system that varies between 1 and 5 meters in thickness. As previously mentioned, this portion is referred to as the weathered Lavery till and exists mainly on the south plateau and exhibits hydraulic conductivities one to three orders of magnitude higher than the more massive unweathered Lavery till.

The three permeable units with hydraulic conductivities significantly higher than the clay tills are considered most vulnerable to contamination from past and present site activities. These include, from uppermost to lowest layers:

- the alluvial/fluvial sand and gravel unit, which is an alluvial fan partially overlying a glacio-fluvial deposit. These two units together overlie the Lavery till on the north plateau

- the intra-Lavery "till-sand," which is a lenticular layer of sand of limited areal extent on the north plateau within the Lavery till

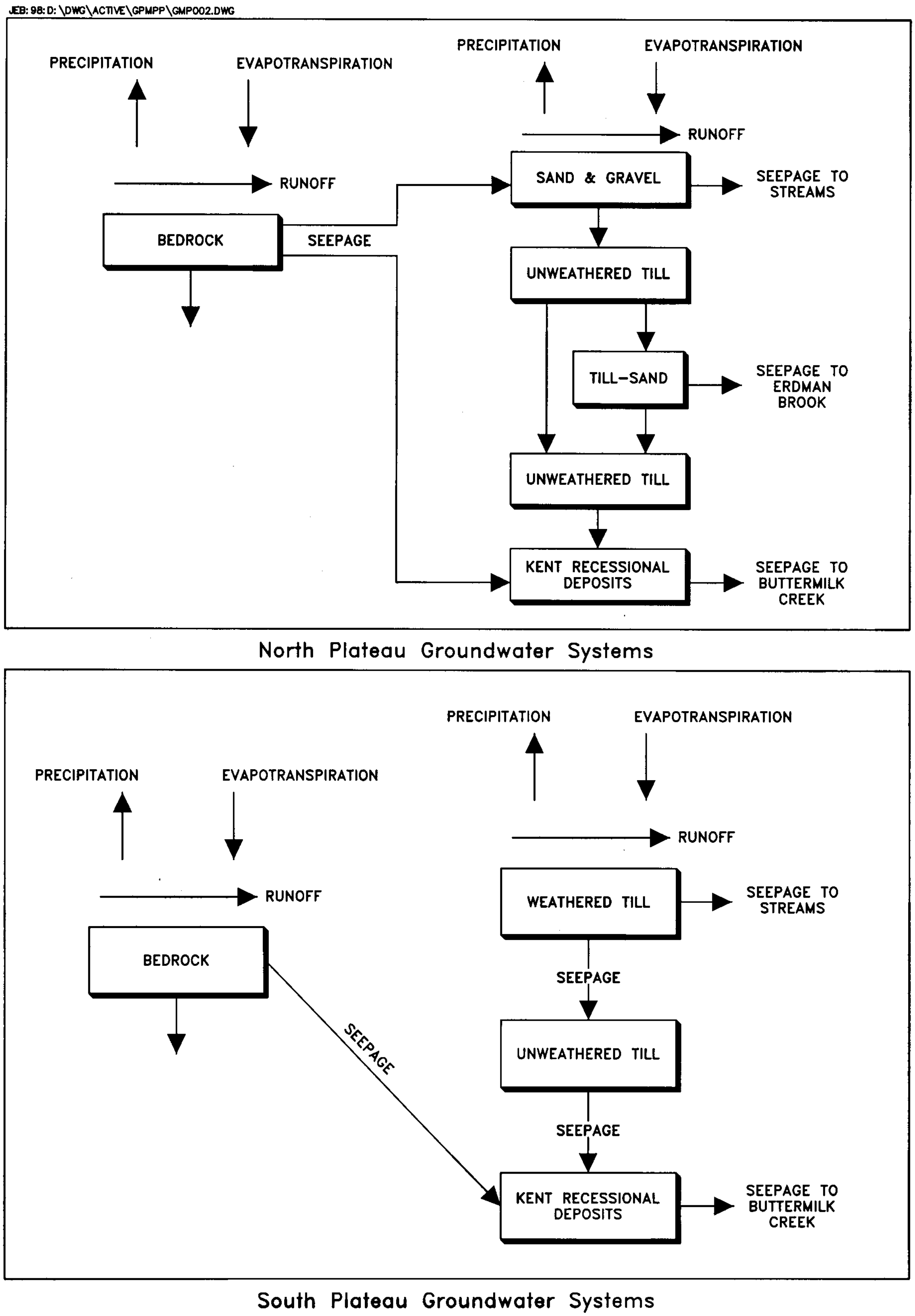
- the Kent recessional sequence, a series of ice-recessional, interbedded lacustrine-kame delta deposits that immediately underlie the Lavery till. This sequence thickens toward the east from the main plant area, and facies changes are common. The sequence receives recharge along a zone of contact with fractured bedrock to the west and also from downward seepage through the overlying Lavery till. Discharge from the unit occurs along the seepage face exposed by the downcutting of Buttermilk Creek.

The first and third units were identified by LaFleur (1979). LaFleur's nomenclature has been used by other investigators who have studied the WNYNSC. Although the sand and gravel unit is composed of two distinct deposits, it is usually considered one unit. The Lavery till-sand was not specifically identified in previous studies as a potential water-bearing unit.

On the north plateau, recharge in the form of precipitation is discharged via storm runoff, evapotranspiration, or infiltration into the sand and gravel unit. This infiltration percolates downward to the unconfined water table, which flows generally toward the northeast. The surficial sand and gravel unit also is recharged by inflow from contact with fractured bedrock west of the site. Discharge from this unit flows into Erdman Brook and Frank's and Quarry Creeks. The sand and gravel aquifer is bounded at its base by the Lavery till. A very small fraction of the water in the surficial sand unit migrates downward into the Lavery till, where it flows downward to the underlying Kent recessional sequence.

The south plateau lacks the surficial sand and gravel unit, thereby directly exposing the Lavery till to extensive subaerial weathering. The dense unweathered Lavery till inhibits the infiltration of a large volume of precipitation that contacts the south plateau; most precipitation leaves as runoff and evapotranspiration. Within the weathered Lavery till, some horizontal groundwater flow within the fracture network presumably emerges as seeps along stream valley walls. A small amount of water in the weathered Lavery till migrates downward into the unweathered Lavery till where it flows vertically downward towards the Kent recessional sequence. The Kent recessional deposits also receive some recharge from the fractured bedrock where it contacts the unit just west of the WVDP. Flow in the Kent recessional sequence is not well-characterized. Available data suggest that flow through the Kent recessional sequence is primarily horizontal toward the northeast, where it discharges from seeps along Buttermilk Creek approximately 914 meters (3,000 feet) from the site (West Valley Nuclear Services 1993). A small portion of the flow in the Kent recessional sequence permeates downward into the underlying silty clay Kent till, which is lithologically similar to the unweathered Lavery till. Figure 2 illustrates the hydrogeologic regime of the north and south plateaus.

FIGURE 2. CONCEPTUAL BLOCK MODEL OF GROUNDWATER SYSTEMS



3.0 GROUNDWATER DETECTION MONITORING

3.1 Groundwater Monitoring Requirements

Regulatory requirements and DOE Orders, in conjunction with current operating practices and historical knowledge of previous site activities, dictate the nature of the groundwater monitoring program at the WVDP. The WVDP does not use groundwater or discharge effluent directly to groundwater. Residences surrounding the site are almost exclusively served by privately owned wells. Moreover, these wells are upgradient from the facility and are not affected by site operations.

Factors in the design of the WVDP groundwater monitoring program include knowledge of the uses of groundwater from the WVDP, applicable regulatory requirements, existing site contamination, and operating facilities in order to establish a groundwater monitoring network that will detect releases and ensure that public health and the environment are protected. The WVDP Groundwater Monitoring Program is designed to support DOE Order 450.1 requirements and the RCRA 3008(h) Administrative Order on Consent.

3.1.1 RCRA 3008(h) Administrative Order on Consent

The RCRA 3008(h) Administrative Order on Consent (Docket No. II RCRA-3008(h)-92-0202), effective March 15, 1992, involves NYSDEC, the EPA, NYSERDA, and the DOE and was established to protect human health and the environment from potential releases of RCRA-regulated hazardous waste and/or hazardous constituents from solid waste management units.

To achieve this purpose, DOE is required to, among other things, perform interim measures at the facility to reduce or eliminate any threats to human health or the environment; perform a RCRA Facility Investigation (RFI) to determine the nature and extent of existing releases and evaluate the potential for future releases of RCRA-regulated hazardous waste or hazardous waste constituents from SWMUs; and perform Corrective Measures Studies (CMS) if an exceedance indicates the potential need to remediate.

The WVDP has completed RFIs for each super SWMU (SSWMU) at the WVDP. NYSDEC has reviewed these documents and has accepted the monitoring recommendations made therein. The WVDP groundwater monitoring program will be modified accordingly in response to changes resulting from future Agency review or regulatory changes.

3.1.2 DOE Order 450.1 - Environmental Protection Program

DOE Order 450.1 requires each site to ensure that their Integrated Safety Management System (ISMS) includes an Environmental Management System (EMS) that, among other items, provides for the systematic planning, integrated execution, and evaluation of programs for a) public health and environmental protection; b) pollution prevention (P2); and c) compliance with applicable environmental protection requirements. In addition, DOE sites must include in their EMS, as applicable, the implementation of a site-wide approach for groundwater protection.

3.2 Site Characterization

This groundwater monitoring program will continue to define groundwater quality and flow patterns, establish the dynamics occurring between the surface morphology and groundwater system, and document areas of contamination that will require detailed attention before completion of the WVDP. Completed characterization work efforts are described in detail in the *RFI Work Plan* (West Valley Nuclear Services, December 1993) and various Environmental Information Documents (EIDs). The RCRA Facility Investigation characterized existing soil, surface water, and groundwater contamination and evaluated the potential for releases from SWMUs. The EIDs and other site-related studies cover characterization of erosion potential; geochemical interactions between solute, soil and groundwater; unsaturated zone parameters; fractures/transport analysis; and overall water mass balance. Characterization has continued with the use of "direct push" groundwater sampling to determine the extent and source of the elevated gross beta levels detected on the north plateau (West Valley Nuclear Services, May 1995b; January 1998; June 1999). Radiological and nonradiological contaminants continue to be evaluated through soil, surface water, and groundwater sampling and analysis. Other samples collected and analyzed are from the low-level waste treatment lagoons and routine site operations.

A limited number of wells were available for groundwater characterization and monitoring through 1989. To expand the monitoring network in 1989-1990, soil boring logs and existing well construction records from 1961 through 1986 were reviewed. Well information was obtained by reviewing several site-specific documents written between 1962 and 1986 and United States Geological Surveys from 1982 through 1985. Evaluation of groundwater monitoring well locations involved separate issues for each plateau. As a result of the initial evaluation of past soil boring and groundwater monitoring well logs, three water-bearing units were identified. (See section 2.0.) The stratigraphic data were used in the subsequent construction of structure contour maps and isopach maps for the layers of particular hydrologic interest. In addition to analyzing stratigraphic and lithologic data, groundwater levels recorded at the site between 1981 and 1989 were tabulated and the data used to construct water table contour maps for the surficial sand and gravel unit on the north plateau and to confirm the direction of flow in the Kent recessional sequence underlying the Lavery till on the south plateau. Based on the historical data, new monitoring well locations were assigned to each SWMU area in order to detect and characterize potential releases.

3.3 Groundwater Monitoring Network

The WVDP uses both federal and state technical guidelines to establish groundwater monitoring networks around the SSWMUs and other areas of potential contamination and boundaries. In reviewing possible monitoring well sites for the individual SWMUs it was not practical to monitor each unit separately where two or more units were close together. Super SWMUs, in which two or more SWMUs are treated as one large unit, replaced SWMUs. The WVDP is responsible for monitoring ten SSWMUs under the GMP. Table 1 lists SSWMUs by name and Figure 3 identifies SSWMU locations on a plan view of the WVDP site.

The site-wide groundwater monitoring expansion in 1989-1990 was designed to further investigate closure alternatives for the site, meet present DOE monitoring guidance, and provide data and documentation to satisfy anticipated regulatory needs. Monitoring expansion increased the number of WVDP groundwater monitoring wells from 17 to 86. The current monitoring program includes the sampling parameters and the actively sampled locations shown in Tables 2 and 3 and the locations monitored for groundwater elevation only (Table 4). See WVDP-190 for a list of all wells at the WVDP along with information concerning ownership and construction.

In general, locations of groundwater monitoring wells are governed by the nature of the groundwater use, existence of vulnerable water-bearing deposits, the location of known and potential sources of pollution, and the rate and direction of flow relative to contaminant sources. Specific locations of the wells installed during the 1989-1990 period were determined after evaluating the following factors: location of existing wells; identification of data gaps; restrictions caused by underground utilities/pipelines and aboveground structures/operations; physical boundaries of the SSWMUs; perceived primary contaminant migration pathways; and the commitment to detect groundwater contamination as early as possible to minimize migration.

Downgradient monitoring wells were located to intercept potential pathways of contaminant migration. The rationales for specific monitoring well locations were documented in a draft Sampling and Analysis Plan (SAP), which was then coordinated with EPA/NYSDEC before well installations. Current monitoring rationales have been modified from the rationales presented in the Groundwater Monitoring Program Review, (West Valley Nuclear Services, May 1995a), to include results of more recently collected data and to incorporate continued monitoring as specified in finalized RFI Reports.

The EPA's *Groundwater Monitoring* TEGD specifies minimum construction and placement criteria that govern well installation and identifies analytical and sampling protocols for monitoring SWMUs. Wells constructed during the 1989-1990 expansion were designed predominantly to specifications provided by the TEGD for groundwater monitoring to support the characterization of SWMUs as part of the RFI required under the RCRA 3008(h) Administrative Order on Consent for the WNYNSC. These groundwater monitoring wells are also used in WVDP site characterization of subsurface glacial stratigraphy, groundwater geochemistry, groundwater contaminant migration pathway evaluation, and for off-site receptor analysis.

Because many of the SSWMUs are downgradient of other SSWMUs, upgradient wells may not reflect true background conditions. In some cases this might lead to indications of groundwater contamination from the monitored SSWMU when actual contamination is from an upgradient source. Therefore, separate background wells that are upgradient of all SSWMUs have been designated. On the north plateau, wells 301, 401, and 706 together represent background conditions for the sand and gravel layer; well 402 represents background conditions for the Lavery till-sand; and well 405 represents background conditions for the unweathered Lavery till. On the south plateau wells 901 and 1008C represent background conditions in the Kent recessional sequence and the weathered Lavery till, respectively. (See Table 3.)

The WVDP recently constructed the Remote-Handled Waste Facility (RHWF) in the far southwestern corner of the north plateau, upgradient of wells 706 and 405. This facility will be used to remotely decontaminate, size-reduce, and package radioactively contaminated materials from the WVDP generated during D&D activities. Therefore wells 706 and 405 can no longer be considered true “background” locations, and new wells were installed upgradient of the RHWF to serve as new background monitoring locations. However, these two wells will continue to be monitored as part of the RHWF network, as discussed below.

During the summer of 2003 four wells were installed in the vicinity of the RHWF to serve as background monitoring points and to monitor groundwater conditions upgradient and downgradient of the RHWF.

Two of the four new wells (WNW1301 and WNW1302) will monitor background conditions in the unweathered Lavery till and sand and gravel unit, respectively, along with upgradient conditions for the RHWF. The remaining two new wells (WNW1303 and WNW1304) will serve as downgradient monitoring locations in the unweathered Lavery till and sand and gravel unit, respectively, for the RHWF. Wells 405 and 706 will now be designated as downgradient monitoring locations for the RHWF in the unweathered Lavery till and the sand and gravel unit, respectively (see Table 3). It is anticipated that the analyte list and monitoring frequency (Table 3) for the RHWF wells will be reduced after adequate initial data have been collected.

Data from downgradient wells are first compared to data from SSWMU-specific upgradient wells and then to data from upgradient facility wells for the specific geologic unit in question in order to thoroughly evaluate potentially changing groundwater quality within a SSWMU. RCRA monitoring parameters are compared with background results in most instances to evaluate potential trends and determine if the result is significant. RCRA monitoring parameters have been focused based on expanded groundwater characterization sampling rounds to address constituents of concern at locations where they have been previously detected or where the potential exists for their detection in groundwater. Certain monitoring parameters such as volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and radioisotopes may not be routinely sampled at background locations because the potential for detection at upgradient locations is extremely low. If a new detection occurs at a location that has not previously yielded that compound, then additional constituents will be analyzed at upgradient locations to 1) evaluate groundwater quality in the area of the unit, 2) determine the extent of constituent migration, and 3) determine the source of the constituent.

Monitoring wells were designed to monitor those water-bearing units that have been identified through extensive site characterization. In places where the water-bearing unit is too shallow to monitor a subsurface SSWMU, or where the uppermost water-bearing unit is too deep for immediate detection of a contaminant release, a less permeable zone at an appropriate depth and lateral proximity to the SWMU is used for monitoring. Monitoring wells range in depth from 1.8 meters to 41.5 meters (6 to 136 ft), depending on the hydrostratigraphy at the well.

Table 3 describes the monitoring well network specific to each SSWMU, including well location with respect to the SSWMU, screened interval, geological unit monitored, analytical parameters, and sampling frequency. The WVDP groundwater monitoring network has been divided into three smaller networks based on the differences in monitoring needs and the geology of each area. The following three sections provide an overview of the monitoring well network with respect to each of these areas.

3.3.1 North Plateau

The monitoring well network on the north plateau provides appropriate detection capabilities for existing chemical and radiological sources and potential sources identified in the RFI reports. The primary radiological concerns on the north plateau are associated with a groundwater plume located northeast of the main plant building and near inactive lagoon 1. Elevated levels of gross beta activity were identified in the main plant plume during sampling and analysis in 1989 and 1990. A seasonal groundwater seep located northeast of the Lag storage areas 3 and 4 near the CDDL was sampled in late 1993 and found to contain elevated gross beta and strontium-90 activity. The extent and direction of contamination present in this plume was characterized during a subsurface investigation and reported in the *Subsurface Probing Investigation on the North Plateau at the West Valley Demonstration Project* (West Valley Nuclear Services, May 1995B). Results clearly indicated that strontium-90 and yttrium-90 were the major beta-emitting isotopes responsible for the elevated gross beta levels. Other isotopes were identified at levels well below their derived concentration guides (DCGs). Additional investigations subsequently were completed to further characterize soil and groundwater conditions within the area of the plume. Results of these investigations were presented in WVDP-298, *1997 Geoprobe Investigation on the North Plateau at the West Valley Demonstration Project* (West Valley Nuclear Services, January 1998) and WVDP-346, *1998 Geoprobe Investigation in the Core Area of the North Plateau Groundwater Plume* (West Valley Nuclear Services, June 1999).

In late 1999, construction of a pilot-scale permeable treatment wall (PTW) was completed in the area of the eastern lobe of the north plateau plume. A network of well points and piezometers were installed specifically to evaluate groundwater conditions in the immediate vicinity of the PTW. Monitoring of the PTW-specific locations is completed under a separate program. If the pilot PTW is sufficiently effective in removing strontium-90 from groundwater, then additional application of this technology may be considered.

Initial measures have been initiated to mitigate contaminant migration. Recovery wells have been installed near the leading edge of the plume and permits acquired to treat groundwater with an ion-exchange unit. Treated water is pumped to lagoons 2, 4, or 5 and subsequently discharged through SPDES outfall 001.

Groundwater seepage along the northeastern (downgradient) edge of the north plateau has been monitored since the first-quarter 1996 sampling event. Groundwater seepage has been observed along the exposure of the sand and gravel unit caused by stream valley downcutting, with some portion of seepage reaching the surface water system. Results of seep sampling supplement groundwater well data and provide a means of ensuring that groundwater with elevated radiological activity is not migrating from the plateau edge.

Seepage samples are collected in conjunction with the routine groundwater well sampling schedule. Results from seep monitoring are time-trended and compared to GSEEP, which has been monitored for many years and has shown no effects from the gross beta plume. Sampling results for volatile organic compounds are compared to results from wells located downgradient of the CDDL.

Special monitoring (SM) parameters, defined in Table 2, are used to monitor the analytical data upgradient of the extraction system to assess potential water quality changes that may affect performance of the treatment system and compliance with the effluent discharge limitations specified in the State Pollutant Discharge Elimination (SPDES) permit. Well 502 was selected as a representative location to sample for SM parameters based on its upgradient position relative to the north plateau groundwater recovery system (NPGRS). SM parameters are not intended to provide an indication of the effectiveness of the NPGRS, but rather to evaluate potential effects of groundwater, passed through the ion-exchange columns, on SPDES outfall 001. The intent of sampling for SM parameters is to provide an early warning of constituent levels in the groundwater near the NPGRS that may affect the limits for certain parameters specified in the SPDES permit.

Volatile organic compounds, slightly above detection levels, have been detected downgradient of the CDDL. Continued monitoring will provide data necessary to determine the need for potential mitigative measures. In addition to groundwater monitoring at the CDDL, inspections and maintenance activities are performed semi-annually per Standard Operating Procedure (SOP) 40-04. SOP 40-04 requires that inspections and any mitigative measures be documented. Documentation data sheets require that observations be noted for such things as ponding, leaching, and erosion. Inspections are specified for the spring and fall, when the water table is usually elevated. During high-water table periods groundwater may come in contact with limited portions of waste in the CDDL. Potential outbreaks would be most likely to occur during high-water table conditions along the north or east sides of the unit. However, the potential for a "leachate" outbreak could occur at any location around the unit. Therefore, the entire periphery is inspected. In accordance with SOP 40-04, if a leachate outbreak is observed, Environmental Affairs will be notified. If sufficient volume is present, Environmental Affairs will arrange for a grab sample of the liquid to be collected and analyzed for indicator parameters and 6 NYCRR Appendix 33 volatile organics. The results will be evaluated and reported in Groundwater Monitoring Exception Reports.

During late 1997, petroleum-contaminated soils were encountered during removal activities regarding an underground storage tank formerly located near the southwest corner of the main warehouse. The WVDP entered into a stipulation agreement with the NYSDEC in April 1999 to remediate the petroleum contaminated soils using a bioventing system. The agreement also included analyzing groundwater collected from well 201 for volatile organic compounds (VOCs) in order to monitor potential contaminant migration via groundwater. The WVDP received a letter from the NYSDEC on May 6, 2003 indicating that no further remedial work was required. Groundwater samples collected from well 201 during 1997 to 2004 did not indicate migration of the VOCs.

3.3.2 South Plateau

Solvent was detected in monitoring wells near disposal holes in the NDA in 1983. This contamination was attributable to containers buried in the NDA between 1968 and 1972, prior to the establishment of the WVDP. The solvent, n-dodecane containing up to 30% tributyl phosphate (TBP), had been used to recover fissile material when the NFS fuel reprocessing plant operated from 1966-1972. The area of solvent migration was at the northeast corner of the NDA. Between 1989 and 1990 interim measures were taken at the NDA to prevent migration of contaminated groundwater from the SSWMU. A groundwater interceptor trench was installed around the north and east perimeter of the NDA to act as a hydraulic barrier between the NDA and surrounding downgradient areas. Monitoring wells installed in 1986 and during the 1989-1990 expansion are used to detect contaminant migration from this unit, SSWMU #9, and other solid waste management units located on the south plateau. In addition to contaminant detection, long-term groundwater monitoring will also include quarterly water-table measurements within and around the interceptor trench to ensure that a hydraulic gradient exists toward the trench. Water elevations will be used to prepare three cross-sectional views of the interceptor trench, which will then be transmitted to NYSDEC. The interceptor trench manholes are inspected periodically to check for signs of blockage of flow. SSWMU #10, the RTS Drum Cell, is the only other SSWMU under DOE cognizance on the south plateau.

3.3.3 Off-site

Environmental surveillance programs are conducted in the vicinity of the WVDP facility to determine the effect of site operations on the environment. Monitoring of private drinking water wells around the site perimeter is an important part of the environmental surveillance program. Off-site wells are sampled to confirm that there are no impacts from site operations on off-site groundwater. Samples are analyzed for the indicator parameters and radiological indicator parameters listed in Table 2, in addition to gamma isotopes and strontium-90. Buttermilk and Cattaraugus Creek surface waters are sampled weekly as part of the routine environmental surveillance program to monitor downgradient conditions because they receive surface water and groundwater from the WVDP. Data are reported in the annual WVDP Site Environmental Report and off-site monitoring well data are provided to private well owners. Figure 4 identifies the locations of most off-site monitoring wells and off-site surface water samplers.

3.4 Program Review and Evaluations

In May 1995 a thorough review of the WVDP groundwater monitoring program was conducted. The program was reviewed with the objective of tailoring the groundwater monitoring program to address appropriate site-wide monitoring parameters as well as constituents of concern specific to individual SSWMUs. This review resulted in a decrease in the total groundwater monitoring network to fifty-nine on-site monitoring locations (See *Groundwater Monitoring Program Review* [West Valley Nuclear Services, May 1995a]). An additional well (NB1S) has remained in the groundwater monitoring program to facilitate technical understanding of flow through the sand and gravel unit on the north plateau. NYSDEC gave conditional approval to implement the May 1995 revisions with the understanding that the groundwater monitoring program relative to the 3008(h) Administrative Order on Consent will evolve as the RFI reports are finalized. This updated WVDP Groundwater Monitoring Program was finalized in May 1995 and implemented during the third quarter 1995 sampling round. Other changes to the program resulting from Agency review of the RFI Reports, quarterly reports, or other applicable information will continue to be incorporated into this GMP.

An initial evaluation of north plateau groundwater seepage sampling was performed in late 1996, after approximately four rounds of quarterly data had been collected. (Not every seep monitoring location could be sampled during every quarterly event because of seasonal dryness.) At the time of the evaluation no seep monitoring locations showed any elevated radiological activity, justifying a reduction in monitoring frequency from quarterly to semiannually. In late 1999 a second evaluation concluded that results from several seep monitoring locations were similar to or less than the background monitoring location and recommended that sampling at four of the monitoring locations (SP02, SP05, SP18, and SP23) be discontinued. This recommendation was approved by the regulatory stakeholders and implemented during the first-quarter 2000 sampling event.

A metals-sampling investigation was performed from the second-quarter 1997 through the first-quarter 1998 to test the effects of modified sampling equipment and methodology on measured concentrations of chromium and nickel. This investigation was prompted because of the wide variability in total chromium and nickel concentrations measured in wells of the sand and gravel unit. The spatial and temporal randomness of the concentrations suggested the source was not related to a release from a solid waste management unit but may be caused by corrosion of the stainless steel well materials and the subsequent sorption of the metal ions to sediment particles entrained in groundwater samples collected from the wells.

The modified equipment and sampling techniques used during the investigation were intended to minimize turbulence in the well and reduce the amount of sediment entrained in the sample. This resulted in reduced chromium and nickel concentrations measured in the modified wells. Sampling results from the control group did not show reductions in metals concentrations. The lower chromium and nickel concentrations reported from the test wells during the pilot program are believed to be more representative of actual groundwater conditions. Based on this evidence, the WVDP proposed eliminating chromium and nickel monitoring at the wells used in this study after the fourth-quarter 1998 (September 1998) sampling period. This proposal was approved and implemented. Since chromium and nickel were the only analytes assigned to wells 203 and 601, elimination of these analytes resulted in the removal of these wells from the current sampling program.

3.5 Well Inspection and Maintenance Program

A comprehensive well inventory identifying all known wells and borings on-site was completed in December 1993. The identification of these wells (using procedure EMP-515*, Groundwater Monitoring Equipment Inspection Procedure)*, was part of EIS site characterization activities and is useful in the current monitoring program. EMP-515 includes procedures and schedules for well integrity inspections. Inspections of wells and other subsurface instruments (i.e., piezometers, lysimeters, and neutron logging holes) located at and adjacent to the WVDP are conducted periodically to ensure the adequacy of the existing wells for site characterization and monitoring purposes; to assist in complying with DOE Orders concerning well construction, protection, and abandonment and RCRA 3008(h) Consent Order requirements. A well inspection schedule will be transmitted to NYSDEC two weeks before the start of inspections. This schedule may be adjusted throughout the inspection period to accommodate weather, accessibility to controlled areas, and availability of support personnel.

After inspections are conducted, a detailed work scope is prepared that conforms to the *TEGD*, when possible. Subsequent maintenance and repairs are then completed.

Since the previous chromium and nickel detections in groundwater monitoring wells on the north plateau were attributed to corrosion of stainless steel well screens (West Valley Nuclear Services, June 1998), selected monitoring wells were inspected using a downhole video camera. The inspections indicated that corrosion buildup on well screens was easily removed using stainless steel wire brushes. Corrosion accumulation is periodically monitored using a submersible video camera according to EMP-515. Wells found to have internal corrosion are cleaned according to EM-519, *Monitoring Well Development*.

3.6 Hydraulic Conductivity Testing and Well Redevelopment

Hydraulic conductivity has been tested in selected wells beginning in FY 1995 and is done periodically to assess the need for well redevelopment. This information is incorporated into a report. Results from hydraulic conductivity testing are combined with field observations gathered during quarterly sampling rounds to select wells for redevelopment. Redevelopment activities are conducted periodically according to EM-519.

TABLE 1
WVDP SUPER SOLID WASTE MANAGEMENT UNITS

SSWMU #	SSWMU Identification
1	Low-Level Waste Treatment Facility
2	Miscellaneous Small Units (MSU)
3	Liquid Waste Treatment System and Sealed Rooms (LWTS)
4	High-Level Waste Storage and Processing Area [High-Level Waste Tank Farm (HLWTF)]
5	Maintenance Shop Leachfield (MSLF)
6	Low-Level Waste Storage Area (LLWSA)
7	Chemical Process Cell Waste Storage Area (CPC-WSA)
8	Construction and Demolition Debris Landfill
9	NRC-Licensed Disposal Area
10	RTS Drum Cell

TABLE 2
GROUNDWATER MONITORING PROGRAM PARAMETER DEFINITIONS

Symbol	Monitoring Parameter	Monitoring Parameter Description
I	Indicator Parameters	pH, specific conductance
RI	Radiological Indicator Parameters	gross alpha, gross beta, tritium
M	Appendix 33 Metals	See Title 6 NYCRR Appendix 33 for list.
V	Volatile Organic Compounds	See Title 6 NYCRR Appendix 33 for list.
SV	Semi-Volatile Organic Compounds	See Title 6 NYCRR Appendix 33 for list and TBP
R	Radioisotopic Analyses (Alpha, Beta, and Gamma Emitters)	C-14 Cs-137 I-129 Ra-226 Ra-228 Sr-90 Tc-99 U-232 U-233/234 U-235/236 U-238 Total Uranium
S	Strontium-90	Sr-90
SM	Special Monitoring Parameters	arsenic aluminum cadmium chromium cobalt copper iron lead manganese nickel selenium barium vanadium zinc mercury silver

TABLE 3
WVDP GROUNDWATER MONITORING NETWORK

NOTES:
1) The (R) designation indicates wells that are part of the RCRA monitoring program. Only monitoring parameters with the (R) designation are used for RCRA monitoring purposes.
2) See Table 2 for description of monitoring parameters.

KEY TO GEOLOGIC UNIT ABBREVIATIONS:
S&G: Sand and Gravel
ULT: Unweathered Lavery Till
KRS: Kent Recessional Sequence
WLT: Weathered Lavery Till
LTS: Lavery Till Sand
BR: Bedrock

Monitoring Well Location	SSWMU	Well Depth (ft)	Unit Monitored	Screened Interval (ft)	Hydraulic Position	Monitoring Parameters	Monitoring Frequency (times/year)
103(R)	3(R) 1	21	S&G	6-21	D	I, RI(R), V(R)	I - 4/yr RI - 4/yr V - 1/yr
104	1	23	S&G	8-23	C	I, RI	I - 4/yr RI - 4/yr
105	1	28	S&G	13-28	C	I, RI	I - 4/yr RI - 4/yr
106	1	14.9	S&G	9.9-14.9	D	I, RI	I - 4/yr RI - 4/yr
107	1	28	ULT	8-28	D	I, RI, V	I - 4/yr RI - 4/yr V - 1/yr
108	1	33	ULT	13-33	D	I, RI, V	I - 4/yr RI - 4/yr V - 1/yr
110(R)	1	33	ULT	13-33	D	I, RI(R), V(R)	I - 4/yr RI - 4/yr V - 1/yr
111(R)	1	11	S&G	6-11	D	I, RI(R), M(R), S, SV(R), V(R)	I - 4/yr RI - 4/yr M - 1/yr S - 1/yr SV - 2/yr V - 1/yr
116(R)	8(R) 1	11	S&G	6-11	U C	I, RI, S, V(R)	I - 4/yr RI - 4/yr S - 2/yr V - 1/yr
201	2	20	S&G	10-20	U	I, RI	I - 2/yr RI - 2/yr
204(R)	2 3(R)	43	LTS	38-43	D	I, RI(R)	I - 4/yr RI - 4/yr
205	2	11	S&G	6-11	D	I, RI	I - 2/yr RI - 2/yr
206	2	37.8	LTS	32.8-37.8	C	I, RI	I - 2/yr RI - 2/yr
208	2	23	LTS	18-23	D	I, RI	I - 2/yr RI - 2/yr
301(R)	3	16	S&G Background (BG)	6-16	U	I, RI(R)	I - 4/yr RI - 4/yr
302	3	28	LTS	23-28	U	I, RI	I - 2/yr RI - 2/yr
401(R)	3(R) 4	16	S&G (BG)	6-16	U	I, RI(R), R	I - 4/yr RI - 4/yr R - 1/yr
402	4	29	LTS (BG)	24-29	U	I, RI	I - 2/yr RI - 2/yr

TABLE 3 *(continued)*
WVDP GROUNDWATER MONITORING NETWORK

Monitoring Well Location	SSWMU	Well Depth (ft)	Unit Monitored	Screened Interval (ft)	Hydraulic Position	Monitoring Parameters	Monitoring Frequency (times/year)
403	4	13	S&G	8-13	U	I, RI, V	I - 2/yr RI - 2/yr V - 1/yr
405	4	12.5	ULT	7.5-12.5	D	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
406(R)	4(R) 6	16.8	S&G	11.8-16.8	D U	I, RI(R), R, V(R)	V - 1/yr I - 4/yr RI - 4/yr R - 1/yr
408(R)	4(R) 3(R)	38	S&G	28-38	D	I, RI(R), R, V(R)	I - 4/yr RI- 4/yr R - 1/yr V - 1/yr
409	4	54	ULT	44-54	D	I, RI	I - 4/yr RI - 4/yr
501(R)	5	33	S&G	23-33	U	I, RI, S, V(R)	I - 4/yr RI - 4/yr S - 1/ yr V - 1/yr
502(R)	5	18	S&G	8-18	D	I, RI, S, SM, V(R)	I - 4/yr RI - 4/yr S - 1/yr V - 1/yr SM - 2/yr
602A	6	13	S&G	8-13	D	I, RI	I - 4/yr RI - 4/yr
604	6	11	S&G	6-11	D	I, RI	I - 4/yr RI - 4/yr
605	6	11	S&G	6-11	D	I, RI	I - 2/yr RI - 2/yr
704	7	15.5	ULT/S&G	5.5-15.5	D	I, RI, V	I - 4/yr RI - 4/yr V - 1/yr
706(R)	7	11	S&G	6-11	D	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
707	7	11	ULT/S&G	6-11	C	I, RI	I - 4/yr RI - 4/yr
801(R)	8(R) 6	17.5	S&G	7.5-17.5	U D	I, RI, S, V(R)	I - 4/yr RI - 4/yr V - 2/yr S - 4/yr
802	8	11	S&G	6-11	D	I, RI, V	I - 4/yr RI - 4/yr V - 2/yr
803(R)	8	18	S&G	8-18	D	I, RI, SV(R), V(R)	I - 4/yr RI - 4/yr V - 4/yr SV - 1/yr
804(R)	8	9	S&G	4-9	D	I, RI, V(R)	I - 4/yr RI - 4/yr V - 2/yr
901(R)	9	136	KRS	121-136	U	I, RI(R)	I - 2/yr RI - 2/yr
902(R)	9	128	KRS	118-128	U	I, RI(R)	I - 2/yr RI - 2/yr
903(R)	9	133	KRS	118-133	D	I, RI(R)	I - 2/yr RI - 2/yr
906(R)	9	10	WLT	5-10	D	I, RI(R)	I - 2/yr RI - 2/yr

TABLE 3 *(continued)*
WVDP GROUNDWATER MONITORING NETWORK

Monitoring Well Location	SSWMU	Well Depth (ft)	Unit Monitored	Screened Interval (ft)	Hydraulic Position	Monitoring Parameters	Monitoring Frequency (times/year)
908(R)	9	21	WLT	6-21	U	I, RI(R)	I - 2/yr RI - 2/yr
909(R)	9	23	WLT	8-23	D	I, RI(R), M(R), R(R), SV(R), V(R)	I - 2/yr RI - 2/yr M - 1/yr R - 1/yr SV - 1/yr V - 1/yr
910(R)	9	30	ULT	25-30	D	I, RI(R)	I - 2/yr RI - 2/yr
NDATR(R)	9	15	WLT	N/A	D	I, RI(R), M(R), R(R), SV(R), V(R)	I - 4/yr RI - 4/yr M - 4/yr R - 2/yr SV - 4/yr V - 4/yr
1005(R)	9(R) 10	19	WLT	9-19	C U	I, RI(R)	I - 2/yr RI - 2/yr
1006(R)	9(R) 10	20	WLT	10-20	C D	I, RI(R)	I - 2/yr RI - 2/yr
1007	10	23	WLT	13-23	D	I, RI	I - 2/yr RI - 2/yr
1008B	10	51	KRS (BG)	46-51	U	I, RI	I - 2/yr RI - 2/yr
1008C(R)	9(R) 10	18	WLT (BG)	8-18	U	I, RI(R)	I - 2/yr RI - 2/yr
1301	N/A	30	ULT	20-30	D	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
1302	N/A	8	S&G	5-8	D	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
1303	N/A	38	ULT (BG)	23-38	U	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
1304	N/A	10	S&G (BG)	6-10	U	I, RI, M, V, SV, R	I - 4/yr RI - 4/yr M - 4/yr V - 4/yr SV - 4/yr R - 4/yr
86-03	8	24.8	S&G	9.8-24.8	U	I, RI, S	I - 4/yr RI - 4/yr S - 2/yr
86-04	1	22.6	S&G	7.6-22.6	C	I, RI	I - 2/yr RI - 2/yr
86-05(R)	1(R) 2	12	S&G	7-12	D	I, RI(R), M(R), S, SV(R), V(R)	I - 4/yr RI - 4/yr M - 1/yr SV - 2/yr V - 1/yr S - 1/yr
86-07(R)	4(R) 6	17.3	S&G	12.3-17.3	D U	I, RI(R), V(R)	I - 4/yr RI - 4/yr V - 1/yr
86-09(R)	3(R) 4(R) 6	24.7	S&G	14.7-24.7	D D U	I, RI(R),S, V(R)	I - 4/yr RI - 4/yr V - 1/yr S - 2/yr

TABLE 3 *(concluded)*
WVDP GROUNDWATER MONITORING NETWORK

Monitoring Well Location	SSWMU	Well Depth (ft)	Unit Monitored	Screened Interval (ft)	Hydraulic Position	Monitoring Parameters	Monitoring Frequency (times/year)
8610(R)	9	112	KRS	97-112	D	I, RI(R)	I - 2/yr RI - 2/yr
8611(R)	9	118.5	KRS	104-118.5	D	I, RI(R)	I - 2/yr RI - 2/yr
86-12(R)	8	16.6	S&G	6.6-16.6	D	I, RI, SV(R), V(R)	I - 4/yr RI - 4/yr V - 4/yr SV - 1/yr
SP-04 SP-06 SP-11	N/A	N/A	S&G	N/A	N/A	RI	RI - 2/yr
SP-12(R)	8	N/A	S&G	Seepage Point	D	I, RI(R), V(R)	I - 2/yr RI - 2/yr V - 2/yr
GSEEP(R)	8	N/A	S&G	Seepage Point	C/D	I, RI, V(R)	I - 4/yr RI - 4/yr V - 2/yr
Main Plant WP-A WP-C WP-H	N/A	28 23 7	S&G	24-28 19-23 3-7	N/A	I, RI	I - 1/yr RI - 1/yr
NB1S	N/A	13	S&G/WLT	8-13	BG	I, RI	I - 2/yr RI - 2/yr

FIGURE 3. ACTIVE GROUNDWATER MONITORING LOCATIONS

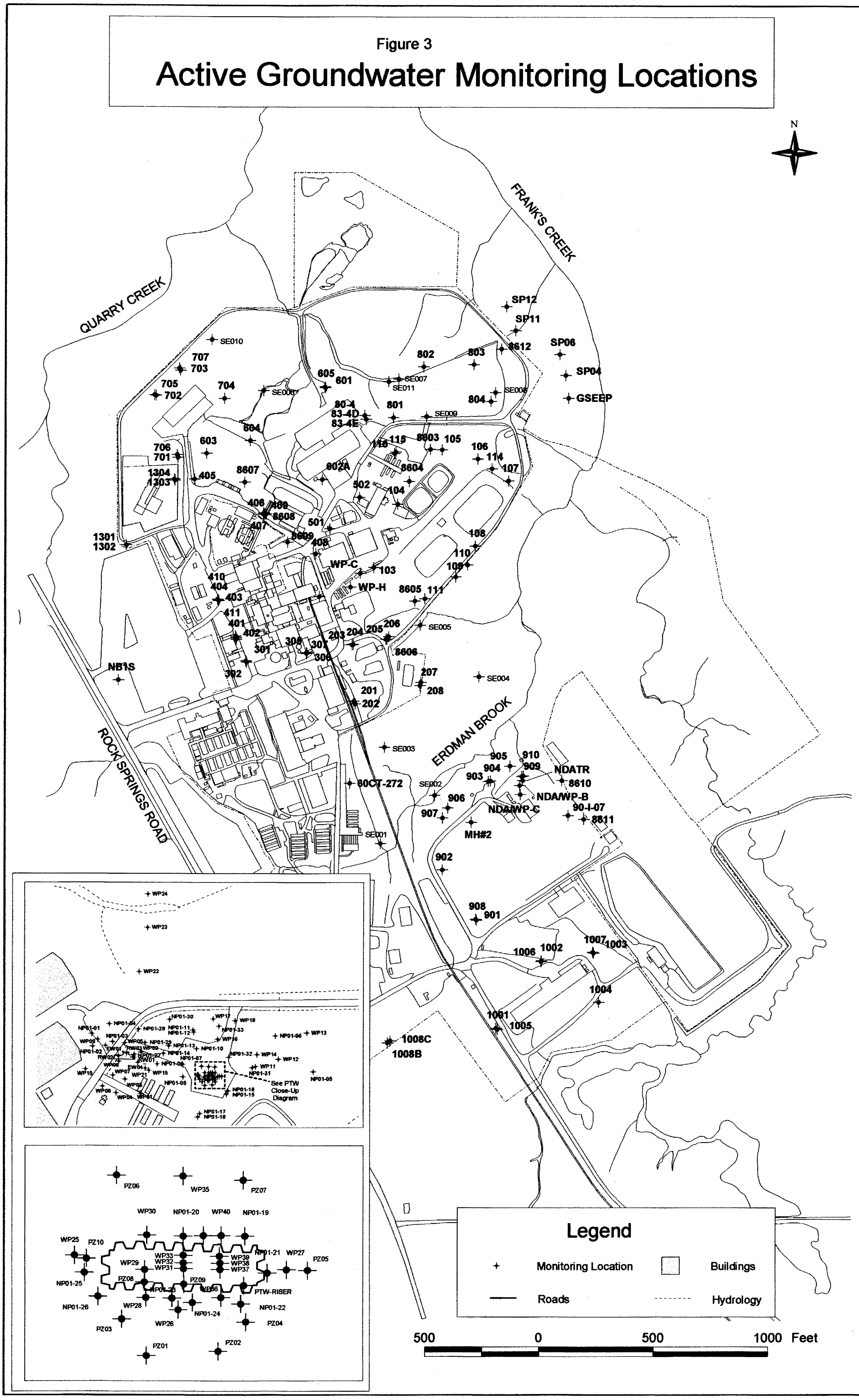
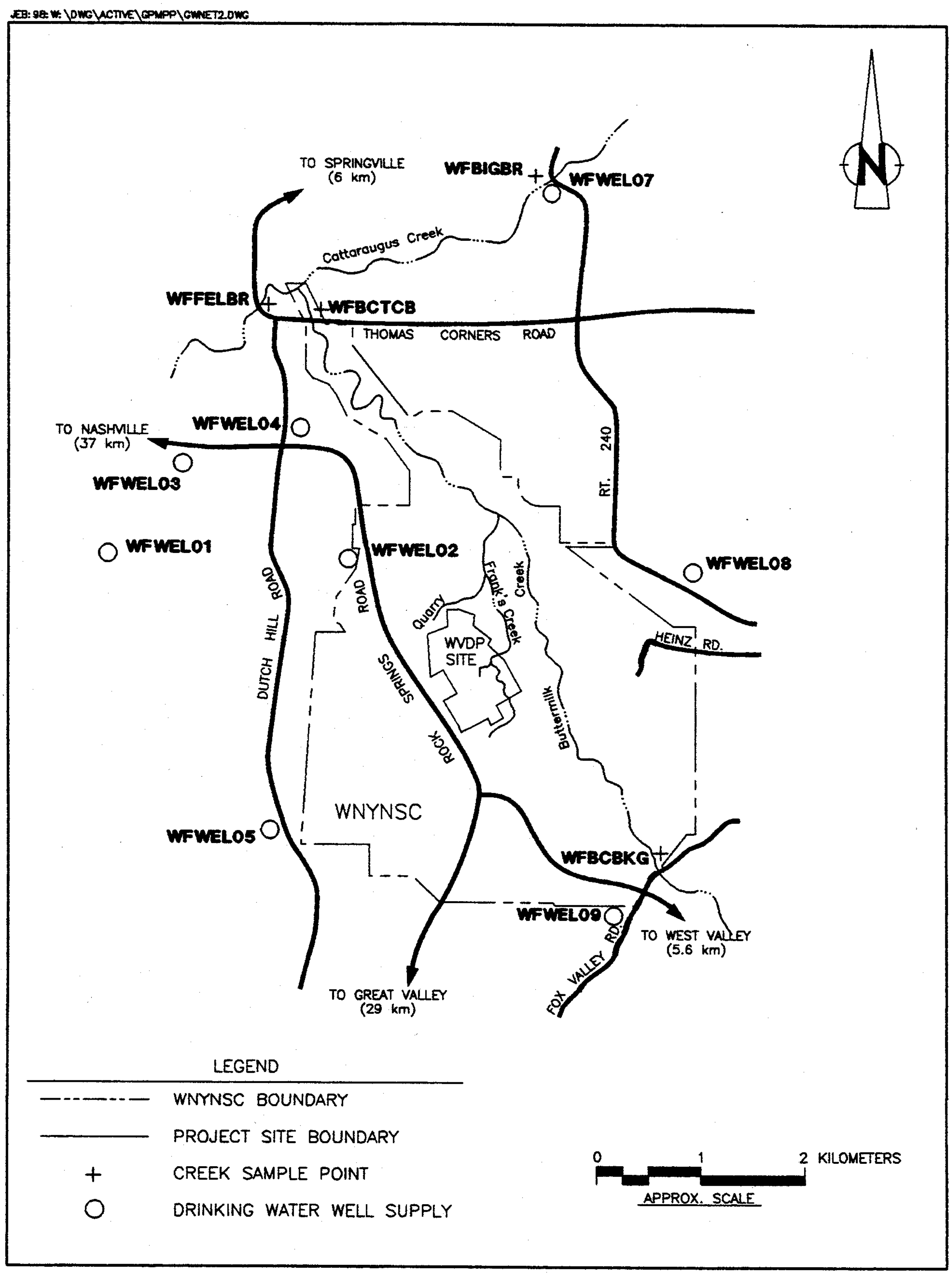


FIGURE 4. LOCATION OF OFF-SITE MONITORING WELLS AND OFF-SITE SURFACE WATER SAMPLERS



4.0 GROUNDWATER SAMPLING

4.1 Analytical Parameters

Both indicator and analytical parameters are used for groundwater monitoring purposes and are selected based on historical data and process knowledge. As additional data are available the program is reviewed and determinations made concerning continued monitoring at each location. Table 2 contains a description of all groundwater monitoring parameters. Table 3 describes the parameters analyzed at each well. The following list identifies the rationale for sampling the various parameters:

- Indicator parameters (pH and specific conductance) are analyzed at all routinely monitored wells for purposes of detecting changing water quality near the SSWMUs.

- Radiological indicators are analyzed at selected RCRA wells because changing radiological groundwater quality may be associated with hazardous constituent migration. In addition, these parameters are analyzed at all routinely monitored non-RCRA wells to monitor changing radiological conditions.

- Baseline conditions for groundwater quality (as per Safe Drinking Water Act criteria) have been established through extensive sampling and analysis efforts since 1991. Based on these data, groundwater quality parameters (chloride, sulfate, nitrate, nitrite, ammonia, bicarbonate alkalinity, carbonate alkalinity, phosphate, silica, sulfide, calcium, magnesium, sodium, potassium, iron, manganese, and aluminum) have been evaluated and determined to be within background ranges for all SSWMUs. In an effort to focus the groundwater program more closely on constituents of concern, groundwater quality parameters were discontinued beginning in December 1996.

- RCRA monitoring for Appendix 33 metals is conducted downgradient of the NDA and inactive lagoon 1.

- Additional chemical and radiological parameters, including volatile organic compounds and semivolatile organic compounds and radioisotopes, are analyzed at selected wells based on process knowledge of SSWMU historical operations and/or previous monitoring results.

- Special monitoring parameters are analyzed at well 502 for use in determining the effect of north plateau mitigative measures on SPDES outfall 001.

4.2 Sampling Frequency

An expanded characterization program was conducted late in 1993 and early 1994 for a specific subset of wells to analyze radiological and nonradiological parameters in addition to routinely analyzed indicator parameters. Results of this analysis, combined with historical groundwater data, additional rounds of new data, and process knowledge form the basis for determining sampling frequencies for each location. Table 3 lists the frequencies of sampling for each parameter at everywell included in the current program. Frequencies for RCRA monitoring locations are specified in RFI reports.

Throughout the RFI review process sampling frequencies were modified, including implementing semiannual sampling at the NDA, with the exception of the NDA interceptor trench sump (NDATR), which is sampled quarterly. The WVDP Groundwater Monitoring Program may also be updated to reflect any changes imposed under DOE Orders.

4.3 Synchronous Water-Level Measurements

Beginning in 1991, water table elevations have been measured as part of routine groundwater sampling. Approximately one week before each sampling event, water-level measurements are checked at all routinely monitored wells and other selected locations. All measurements are collected per EM-6, *Groundwater Sampling,* during the week before the start of sampling to provide an essentially "synchronous" set of water-levels for all hydrostratigraphic units at the WVDP. Static water level contour maps are subsequently produced to identify local and sitewide groundwater flow and gradients. Table 4 lists the monitoring locations that are measured quarterly for water elevations in addition to locations actively sampled. Water levels in active wells are measured again at the time of sampling to determine purge volumes.

TABLE 4
MONITORING LOCATIONS USED FOR POTENTIOMETRIC MEASUREMENTS IN ADDITION TO ACTIVELY SAMPLED LOCATIONS

North Plateau				South Plateau			
109	114	115	202	904	905	907	1001
203	207	305	306	1002	1003	1004	NDA\WP-B
307	404	407	410	NDA\WP-C	MH#2	90-I-7	96-I-01
411	601	603	701	96-I-02	96-I-03	96-I-04	
702	703	705	80-4	1109A (NYSERDA-owned)			
83-4D	83-4E	8606	8608				
EW01	EW04	WP04	60CT272				
SE001	SE002	SE003					
SE004	SE005	SE006	SE007				
SE008	SE009	SE010	SE011				

Surface water elevations are measured on a quarterly basis at eleven selected locations on the north plateau and are recorded concurrently with the quarterly groundwater elevation measurements. The eleven locations (SE001 through SE011; see Table 4) are areas where local groundwater seepage from the sand and gravel unit is suspected of being the source of the standing surface water. Surface water elevation data collected from these locations provides information in areas of the north plateau where there are no wells, thereby providing additional definition of the potentiometric surface.

Elevation reference hubs were established at each of the eleven selected locations during July and August 1998. The hubs consist of solid steel rods that extend approximately 2 feet above the ground surface and are marked and identified with bicycle flags. Elevations were established on top of each hub. Individual hub identifications were designated WNSE001 through WNSE011, according to existing site conventions (i.e., W = water, N = on-site, SE = surface elevation). The hubs are also depicted on Figure 3.

The vertical distance from the top of each hub to the surface of the standing water are measured to the nearest hundredth of a foot and recorded in the field log book for each location. The measurements are entered in the Laboratory Information Management System (LIMS) along with groundwater depth measurements from the monitoring wells. The surface water measurements are converted to elevations in a manner similar to the conversion of groundwater depths to elevations. Surface water elevations are incorporated into the quarterly groundwater contour map for the sand and gravel unit on the north plateau.

During periods of low water table, some staked areas may not show any groundwater seepage. In such cases a reading of "dry" is recorded for that location. Surface water elevation hubs are not measured if they are buried under deep snow or ice or if severely inclement weather results in a potentially unsafe condition, especially in radiologically contaminated areas.

4.4 Regulatory Agency Sample-Splitting Program

Environmental sample sharing and co-location of measurement points with the New York State Department of Health (NYSDOH) and the NRC will be conducted upon request to ensure that selected samples and locations are routinely measured by two or more independent organizations. However, continuation of NYSDOH's sample-splitting program is contingent upon funding from the NRC. NYSDEC will be notified before routine sampling events.

5.0 GROUNDWATER MONITORING DATA MANAGEMENT

Specific methods for acquiring, processing, documenting, evaluating, reporting, and maintaining environmental monitoring and surveillance data are noted in EMP-11*, Documentation and Reporting of Environmental Monitoring Data*. EM-1, *Sample Identification and Information Flow Management,* identifies specific data management processes, including the LIMS, for groundwater data management.

5.1 Data Validation

Data validation is the process by which sample data are evaluated in terms of analytical accuracy and precision, representativeness, completeness, and comparability for acceptability of a specified purpose. The data validation process consists of data reduction, review, certification, fitness qualification, and verification. An initial data quality review is performed by a WVNSCO-approved laboratory as specified in a contractual agreement between the laboratory and WVNSCO. All data is checked for precision and accuracy at the bench level by the analyst performing the analysis and again by the laboratory manager or designee before submitting the data package to the laboratory Project Manager. Data is validated by the WVNSCO subcontracted data validation group in accordance with EM-67, *Organics Data Validation;* EM-68, *Inorganics Data Validation;* and EM-74, *Radioanalytical Data Validation*. Environmental Monitoring Procedure EM-108, *Data Validation,* establishes the responsibilities and describes the validation process, including the level of information and quality assurance required with each analytical data package.

Data validation for all regularly scheduled groundwater monitoring will be conducted under WVNSCO Level 1 validation. WVNSCO Level 2 data validation will be conducted for specially requested, non-routine groundwater monitoring purposes. WVNSCO Level 1 validation is based on *EPA SW-846*, *Standard Methods for Examination of Water and Wastewater Sampling,* and the *NYSDOH Environmental Laboratory Approval Program (ELAP)* manual. WVNSCO Level 2 validation encompasses WVNSCO Level 1 but also includes review of supporting data (i.e., calibration information instrument responses/raw data). WVNSCO Level 2 validation is based on EPA Region II Data Validation Standard Operating Procedures (SOPs) and NYSDEC Analytical Services Protocol (ASP).

5.2 Data Evaluation and Trigger Limits for Analytical Data

Groundwater monitoring data will be evaluated and reviewed by the DOE and WVNSCO on a quarterly basis to assess analytical trends and determine appropriate monitoring requirements for the program. Groundwater trigger limits were developed in 1995 for all chemical and radiological analytes to expedite data exception notification. The WVDP uses trigger limits to assist in data evaluation and to determine where changes in geochemistry may be occurring. Statistical prediction intervals were calculated to determine intra-well trigger limits that are independent of the determination of a release from a SSWMU.

Trigger limits have been entered in the LIMS database and results exceeding these pre-set limits initiate additional actions. The first action that occurs after exceedance of a trigger limit is confirmation of the result followed by a technical evaluation of historical data. Additional supporting documentation from the laboratory may be requested immediately to verify the result. The data point is reviewed and compared to historical results and background conditions to evaluate potential trends and determine if there is an indication of changing water quality conditions. Further actions may include resampling and analysis, investigating hydrogeologic conditions, and changing the future monitoring agenda.

The use of groundwater trigger limits provides for the rapid identification of analytical results that are either above or below the pre-set limit. The advantages of identifying results as they are entered into the site database are manifested in the earlier evaluation of data reliability and the subsequent formulation of appropriate responses.

The process of setting trigger levels involves the evaluation of historical results from individual wells and background wells. The time-trending of several years of groundwater indicator results from all wells has provided a perspective on important features such as typical ranges of results, outlier data, seasonal variation, and potentially changing geochemical conditions.

For purposes of setting trigger levels, upper and lower intra-well prediction intervals at the 95% confidence level were employed because they estimate the bounds on expected concentrations of future analytical results. This computation has an associated false-positive rate of 5%. Since 1999, prediction intervals were computed using S-Plus 2000 (Mathsoft, May 1999) and Environmental Stats for S-Plus (Millard 1998). These two programs were chosen to replace GRITS/STAT (the Nationwide Groundwater Information Tracking System/Statistical Analysis System designed by the EPA), a statistical program that is not

Y2K-compliant. The new programs are Y2K-compliant and have other features compatible with current WVDP environmental data management practices. A comparison of prediction intervals calculated using both the old and new programs indicated good agreement.

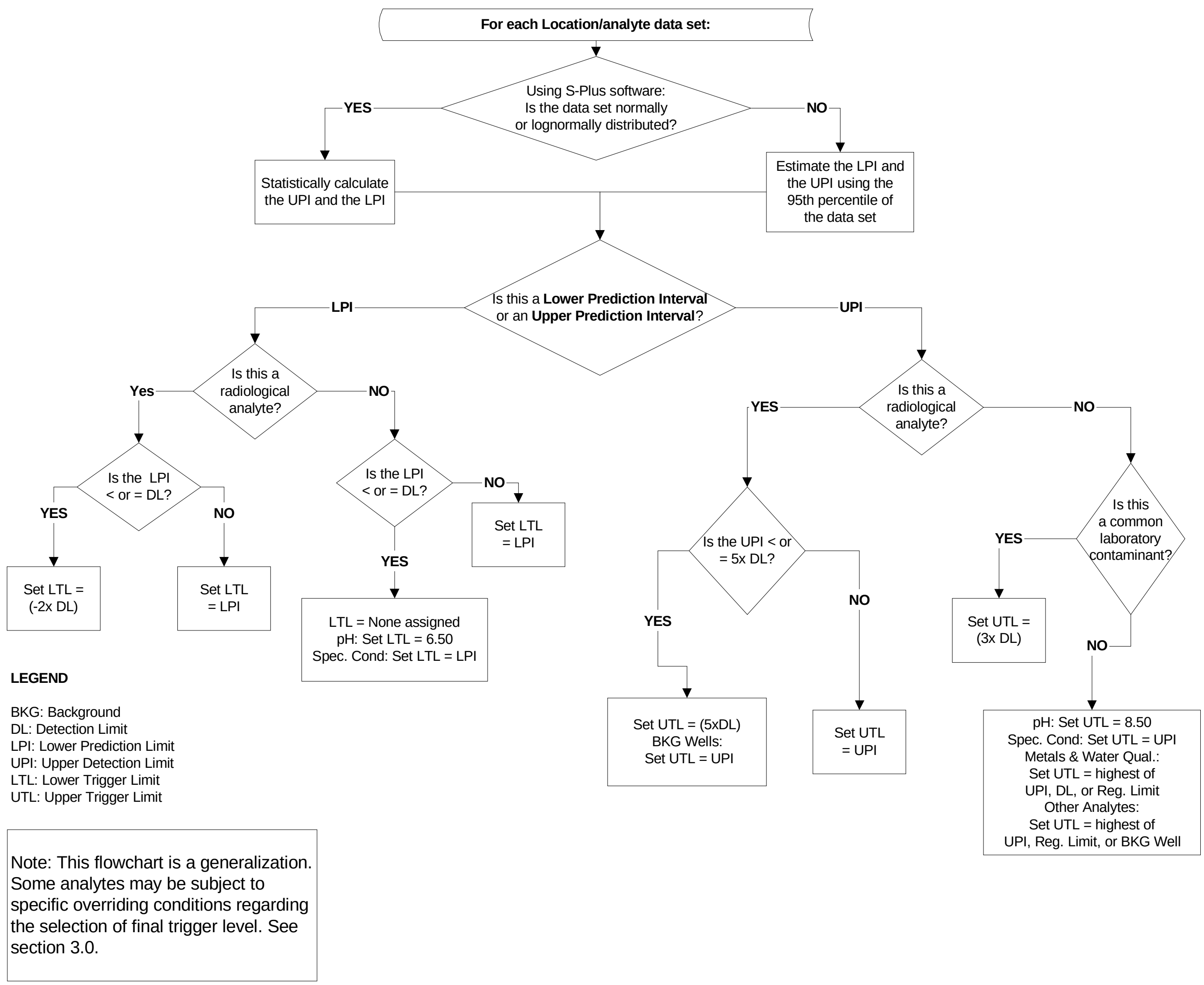
Monitoring results from April 1991 through the present were designated as historical observations. Any future result found to exceed or lie below these preset upper and lower limits triggers an evaluation and, if necessary, additional action.

Evaluations of exceptions include an assessment of data reliability and possible random variation resulting from sources such as variability in laboratory measurements, variability in sampling or sample handling, and/or natural environmental conditions. In all cases, data sets were first tested for normality and logarithmic normality using S-Plus and Environmental Stats. (Lognormality could not be determined if the data sets contained zero or negative values.) Prediction intervals were then assigned using the method best suited to the results of the normality test.

A complete discussion of prediction interval calculations, determination of trigger limits, and a flowchart can be found in the *Annual Revision of Groundwater Trigger Limits for Groundwater Sampling Year 2005* (URS Corporation, 2004).

A confirmed exceedance of a trigger limit at a SSWMU where sampling frequency has been reduced from quarterly to semiannual (i.e., SSWMU #9 with the exception of monitoring location NDATR), may result in an increase to quarterly sampling. Further evaluation will determine if future sampling should continue on a quarterly or semiannual basis. Trigger limits will be recalculated annually to incorporate new rounds of available data.

FIGURE 5. GROUNDWATER MONITORING TRIGGER LIMIT DECISION FLOWCHART



5.3 Data Evaluation and Trigger Levels for Elevation Data

Trigger levels have also been established for groundwater elevation data. Raw field data are recorded quarterly as depth to standing water below a previously established referenced elevation (measuring point) for each monitoring location. The depth values are entered in the LIMS and therefore the trigger levels are also maintained as depth values. The corresponding groundwater elevations are calculated as part of subsequent mapping and database uploading procedures.

Groundwater depth alarm levels were based on monitoring well installation information. For example, the high alarm level was typically set equal to the bottom depth of the well, referenced to the established measuring point elevation. Low alarm levels were typically set equal to zero. Low and high warning trigger levels were typically based on the historical minimum and maximum water depth measurements, respectively, for each monitoring location.

Quarterly groundwater depth measurements and surface water reference measurements are entered in the LIMS. Each measurement is automatically compared to present trigger levels upon entry in the LIMS. Any value falling outside the range of the trigger levels generates a data exception report for that location.

Groundwater-level exception reports are used as part of the quality control process each quarter. Follow-up for groundwater level exceptions includes checking field log book entries against LIMS values. If these agree, then other sources of the error are investigated.

When errors are confirmed or are highly probable, recommended corrections are presented to the WVNSCO cognizant engineer. The corrections are incorporated only after concurrence by the cognizant engineer. Once approved, corrections will be entered in the field log book by drawing a single line through the original entry, entering the corrected value, and initialing and dating the change. Corrections will also be made in the LIMS and other appropriate databases (e.g., ArcView®).

5.4 Data Reporting

Results from the WVDP groundwater monitoring program are presented in the annual Site Environmental Report. This report, which contains a complete section on the groundwater monitoring program and results obtained throughout the year, is available to NYSDEC, other government agencies, and the general public.

Confirmation of a result that exceeds an upper trigger level for RCRA monitoring purposes initiates an examination of historical trends, possible resampling, and a report to NYSDEC. On a quarterly basis an exceedance report is submitted to NYSDEC that lists RCRA monitoring parameters that were above pre-set ranges at RCRA monitoring wells. Appropriate notifications will be made if data from non-RCRA monitoring locations indicate a previously unidentified source or a potential threat to human health or the environment.

The WVDP will provide NYSDEC with data that are outside the pre-set trigger levels, as identified in Table 5, in the form of a summary table, no later than thirteen weeks from the scheduled completion of the corresponding sampling event. This notification will be based on the following approximations of the data-analysis cycle:

- Analysis of all samples for radiological and chemical parameters by contract laboratories and the on-site laboratories: seven weeks from the last sample collection
- Data validation: two weeks
- Exception reporting from LIMS and data evaluation: two weeks
- Generation of NYSDEC Exception Report and Department of Energy (DOE), West Valley Nuclear Services (WVNSCO) concurrent review: one week
- Incorporation of comments and WVNSCO transmittal to DOE and/or NYSDEC: one week
- Total completion time: thirteen weeks.

Table 5 identifies the trigger levels specific to each monitoring parameter and the possible follow-up actions. The last column identifies whether a certain situation will result in notification of NYSDEC. This table can be used to identify all possible monitoring outcomes and to identify the corresponding actions and notifications.

5.5 Database Maintenance and the Geographic Information System (GIS)

The WVDP has established a geographic information system (GIS) using ArcView software for groundwater monitoring data and associated information. The GIS provides map-based data management capabilities. Members of the WVDP ArcView® User Group are authorized to use the GIS. The groundwater database files that are linked to the GIS are updated quarterly with validated data as follows: groundwater elevations are uploaded within ten business days after they are measured, field data (pH and specific conductance) are uploaded within ten business days after completion of quarterly sampling, and analytical data are uploaded within ten business days after release by the Data Validation group.

TABLE 5
GROUNDWATER MONITORING TRIGGER LEVELS, ACTIONS, & NOTIFICATIONS

Parameter	Conditions	Basis of Trigger Level Determination	Monitoring Result	Action	NYSDEC Notification Required?	
pH	All Wells	pH<6.5 or pH>8.5 or as specified	6.5 # pH # 8.5	No Action Required	No Notification Required	
			Above Upper Trigger Level or Below Lower Trigger Level	Confirm Result, Perform Technical Evaluation, Possibly Resample	No Notification Required	
	TRIGGER LEVELS FOR WELLS WITH DETECTIONS OUTSIDE RANGE WERE SET BASED ON HISTORICAL PREDICTION INTERVALS					
Specific Conductivity	All Wells	Upper and Lower Prediction Interval	Below Upper Trigger Level and Above Lower Trigger Level	No Action Required	No Notification Required	
			Above Upper Trigger Level or Below Lower Trigger Level	Confirm Result, Perform Technical Evaluation, Possibly Resample, Determine if Additional Parameters Will Be Added	Parameters Added	Notification Required
					No Parameters Added	No Notification Required
VOCs and SVOCs Including Lab Contaminants	Selected Wells	Upper Prediction Interval or Detection Limit (Higher of 2) Laboratory Contaminants: Upper Prediction Interval or 3X Detection Limit (higher of 2)	Below Trigger Level or Detection Limit	No Action Required	No Notification Required	
			Above Upper Trigger Level or Detection Limit	Confirm Result, Perform Technical Evaluation, Possibly Resample	Notification Required	
Gross Alpha	All Wells	Upper Level Set at 75% DCG for Am-241 and Lower Level Set at -2X Detection Limit	Below Upper Trigger Level and Above Lower Trigger Level	No Action Required	No Notification Required	
			Above Upper Trigger Level or Below Lower Trigger Level	Confirm Result, Perform Technical Evaluation & Examine Trends, Possibly Resample, Determine Future Actions	Gross Alpha Not Used as an Indicator Parameter for RCRA Monitoring Purposes	No Notification Required
					Gross Alpha Used as an Indicator Parameter for RCRA Monitoring Purposes	Notification Required (Results Below Lower Trigger Level Would Not Require Notification)

<table>
<tr><th>Parameter</th><th>Conditions</th><th>Basis of Trigger Level Determination</th><th>Monitoring Result</th><th>Action</th><th colspan="2">NYSDEC Notification Required?</th></tr>
<tr><td rowspan="6">Gross Beta, Tritium and Radiological Isotopes</td><td rowspan="3">All Wells Usually Below Detection Limits</td><td rowspan="3">Upper Trigger Level Set at Upper Prediction Interval or 5X the Detection Limit and Lower Trigger Level Set at -2X the Detection Limit</td><td>Below 5 X DL</td><td>No Action</td><td colspan="2">No Notification Required</td></tr>
<tr><td rowspan="2">Above 5 X the Detection Limit or Below -2X the Detection Limit</td><td rowspan="2">Confirm Result, Perform Technical Evaluation & Examine Trends, Possibly Resample, Determine Future Actions</td><td>Parameter Not Used as an Indicator for RCRA Monitoring Purposes</td><td>No Notification Required</td></tr>
<tr><td>Parameter Used as an Indicator for RCRA Monitoring Purposes</td><td>Notification Required (Results Below the Lower Trigger Level Would Not Require Notification)</td></tr>
<tr><td rowspan="3">All Wells Usually Above 5X Detection Limits</td><td rowspan="3">Upper Trigger Level Set at Upper Prediction Interval and Lower Trigger Level Set at Lower Prediction Interval or -2X the Detection Limit</td><td>Between Upper Trigger Level and Lower Trigger Level</td><td>No Action</td><td colspan="2">No Notification Required</td></tr>
<tr><td rowspan="2">Above Upper Trigger Level or Below Lower Trigger Level</td><td rowspan="2">Confirm Result, Perform Technical Evaluation & Examine Trends, Possibly Resample, Determine Future Actions</td><td>Parameter Not Used as an Indicator for RCRA Monitoring Purposes</td><td>No Notification Required</td></tr>
<tr><td>Parameter Used as an Indicator for RCRA Monitoring Purposes</td><td>Notification Required (Results Below the Lower Trigger Level Would Not Require Notification)</td></tr>
<tr><td rowspan="2">Special Monitoring Parameters</td><td rowspan="2">Selected Wells</td><td rowspan="2">Warning Level for 001 SPDES Violation</td><td>Between Upper Trigger Level and Lower Trigger Level</td><td>No Action</td><td colspan="2" rowspan="2">No Notification Required</td></tr>
<tr><td>Above Upper Trigger Level or Below Lower Trigger Level</td><td>Confirm Result, Perform Technical Evaluation, Compare results to Recovery Wells, Possibly Resample</td></tr>
<tr><td rowspan="2">Metals</td><td rowspan="2">Selected Wells</td><td rowspan="2">Individual Prediction Interval, Background Prediction Interval, or Proposed Subpart S Limit (Highest of 3)</td><td>Below Upper Trigger Level and Above Lower Trigger Level</td><td>No Action</td><td colspan="2">No Notification Required</td></tr>
<tr><td>Above Upper Trigger Level or Below Lower Trigger Level</td><td>Confirm Result, Perform Technical Evaluation, Possibly Collect and Analyze a Filtered Sample at Representative Locations</td><td colspan="2">Notification Required (Results below the Lower Trigger Level Would Not Require Notification)</td></tr>
</table>

6.0 GROUNDWATER MONITORING QUALITY ASSURANCE & QUALITY CONTROL

The Quality Assurance Program at the WVDP implements requirements contained in 10 CFR Part 830.120, *Quality Assurance*, and DOE Order 5700.6C, *Quality Assurance*. The following documents form the foundation for quality assurance activities at the WVDP and provide a basis for the WVNSCO integrated quality assurance program:

- ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*
- NYSDEC, *Resource Conservation and Recovery Act Quality Assurance Project Plan Guidance* (QAPjP)
- Office of Civilian Waste Management, DOE/RW-0333P, *Quality Assurance Requirements and Description for High-Level Waste*
- ANSI/ASQE E-4, *Quality Systems Requirements for Environmental Programs*
- WVDP-111, *WVNS Quality Assurance Program*
- WVDP-099, *WVNS Environmental Quality Assurance Plan*
- WVDP-002, *Quality Assurance Manual*
- EMP-103, *Self-Assessments for Environmental Programs*

The groundwater monitoring program is regularly reviewed for accuracy, compliance, proper records management, timely calibration of equipment, training and proficiency of personnel, and adherence to accepted procedures. Routine reviews, internal appraisals, and external audits by regulatory agencies including NYSDEC, are also an integral part of the program.

Specific quality control requirements for each collection activity or analysis are based upon requirements or guidance in SW-846*, Standard Methods for the Examination of Water and Wastewater*, RCRA guidance documents, HASL-300, and NYSDOH's *Environmental Laboratory Approval Program (ELAP) Certification Manual*. Site-specific environmental monitoring procedures detail required quality control practices. Field quality control practices are addressed in section 7.4 of EM-6. Appendix A contains a list of these site-specific procedures.

6.1 Sampling Methods and Equipment

Groundwater sampling equipment is described in EM-6*, Groundwater Sampling*. Sample collection procedures are described in detail in EM-6 and are specific to sampling groundwater wells with bailers or dedicated pumps such as bladder pumps. EM-6 addresses container labeling, measurement techniques, and specific precautionary procedures to minimize cross-contamination. Dedicated sampling equipment is used in preference to non-dedicated equipment to minimize the risk of cross-contamination. Bladder pumps use compressed air to gently squeeze a Teflon® bladder located near the bottom of the well, thus expelling the water out of the sampling line. Bladder pumps provide an effective system for groundwater sampling collection and also reduce agitation of the water column. In 1991 bladder pumps were permanently installed in seventy-three wells to effectively reduce labor intensity and the potential for cross-contamination.

EM-55*, Measuring pH, Conductivity, and Temperature of Field Samples*, outlines the methodology for the use, calibration, and maintenance of the YSI Water Quality Monitor (Model 556MPS and Model 3560). The procedure is written to ensure that representative sample readings are collected and cross-contamination between readings is prevented. To facilitate proper sample collection each well casing is clearly labeled with the well location code identifier (e.g., WNW-0401). A laminated plastic card attached to each well also lists geographical coordinates, SSWMU assignment, geological unit monitored, well depth below grade, water level reference, well depth from riser top, reference level elevation, riser material, screen length and interval, sampling protocol for the well, and whether or not the purge water requires containment.

In accordance with EM-19, *Sample Container Preparation and Sample Preservation,* sample containers are to meet container guidance specifications listed in Table 1 of EM-19. All containers used for groundwater collection are to be purchased from an outside vendor as certified pre-cleaned to specifications found in *Specifications and Guidance for Contaminant Free Sample Containers* (EPA) or Appendix D of NYSDEC RCRA QAPjP. Samples to be shipped are preserved and stored in a manner suitable to the required analysis as outlined in EM-19*, Sample Container Preparation and Sample Preservation,* the NYSDOH *ELAP Certification Manual*, and/or the instructions of the receiving laboratory. Holding times are determined by appropriate regulatory agencies and specify the maximum length of time a properly preserved sample may be stored from the time of collection to the time of analysis without significant degradation of sample integrity. Holding times are summarized in Table 1 of EM-19. All samples are shipped to minimize sample degradation and in accordance with EM-52, *Environmental Sample Receipt, Handling, Storage, Packaging and Shipment*. Adherence to these practices ensures sample integrity with regard to container selection and sample preservation and provides pre-analysis documentation of sample container quality.

All field and laboratory procedures emphasize the importance of representative sample collection. Procedures incorporate steps that ensure that cross-contamination between sampling locations does not occur. Sampling materials are not reused unless they are dedicated to a particular site or have been thoroughly cleaned with detergent and rinsed with distilled water. Laboratory procedures detail the specifics of best laboratory management practices in order to minimize the chance of introducing contamination after the sample is collected.

6.2 Documentation and Chain-of-Custody

Routine groundwater monitoring program samples are logged into the LIMS before each pre-scheduled collection event. Samples are assigned an identification number, location code, filtration status, preservative, and parameter list for which the sample will be analyzed. Sample containers are labeled before samples are collected and field data is entered on the label at the time of collection. All samples delivered to the Environmental Laboratory for analysis or shipment are accompanied by a chain-of-custody form. Upon receipt, sample information is entered into the LIMS. Additional quality control procedures include double data entry by recording information in method-dedicated laboratory notebooks and on data sheets. Data sheets, logs, and notebooks are routinely audited to ensure that information concerning each sample is traceable and retrievable before becoming part of a permanent record.

EMP-11, *Documentation and Reporting of Environmental Data,* provides guidance pertaining to the acquisition, processing, documentation, evaluation, and reporting of environmental monitoring and surveillance data. Specifics of the procedure include data collection, data reduction, data evaluation, and data reporting. EMP-11 addresses estimating uncertainty, averaging replicate and duplicate samples, averaging periodic measurements, and the reporting of outliers. As detailed in EMP-11, outliers are to be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. If the outlier is not attributable to error it should be included in the data set. Records of environmental measurement data are maintained and protected from damage or loss as specified in EMP-105*, Environmental Monitoring Records Management.* EM-105 encompasses all systems (e.g., paper, electronic, graphic, or photographic) that document work conducted as part of environmental assessment monitoring activities at the WVDP. EMP-105 applies only to quality records that have not yet been forwarded to the WVNSCO Master Records Center.

6.3 Laboratory Procedures and Practices

Procedures specifically applicable to the collection and analysis of groundwater samples are contained in WVDP-214, *Environmental Monitoring Procedures Manual*. Procedures specific to site characterization activities are discussed in the *RFI Work Plan* (West Valley Nuclear Services, December 1993). In 1992 the Environmental Laboratory implemented the graded conduct of operations described with DOE Order 5480.19, *Conduct of Operations for DOE Facilities* (U.S. Department of Energy, July 9, 1990).

All laboratory personnel meet specific requirements before being qualified to perform unsupervised duties. EM-107*, Training of Environmental Laboratory Personnel,* describes required training for laboratory practices conducted by Environmental Laboratory personnel. Specifics of the procedure include completion of an indoctrination checklist for new employees; on-the-job-training in field sampling and measurement procedures conducted by a qualified trainer; and completion of an Environmental Monitoring Training Review Form for each procedure learned.

Methods for on-site analyses are described in the *Environmental Monitoring Procedures*, many of which are directly adapted from SW-846, *Standard Methods for Examination of Water and Wastewater* (3rd edition) or DOE's *Environmental Laboratory Procedures Manual,* HASL-300. Analysis for RCRA monitoring purposes will be conducted in accordance with the SW-846 procedures. Other isotopic or nonradiological analyses conducted in approved off-site contract laboratories are required to conform to documented and approved methods of analysis such as those in SW-846, HASL-300, or Standard Methods as specified by the WVDP in each analytical services contract. Both on-site and off-site laboratories must analyze samples for identification and/or quantification in accordance with procedures applicable to the specific measurement device.

The Environmental Laboratory collects and prepares samples and conducts most direct radiometric analyses of groundwater, including gross alpha, gross beta, tritium, gamma isotopic, and strontium-90. As of

October 1, 1994, field pH and conductivity were the only nonradiological analyses performed on-site; all other analyses are provided by off-site contract laboratories.

Off-site laboratories provide most of the analyses requiring radiochemical separation as well as analyses for most chemical parameters. Off-site laboratories must be approved according to WVNSCO procurement, technical, and quality assurance policies. In addition, laboratories performing nonradiological analyses are required by contract to be certified by NYSDOH. Laboratories that conduct analytical work in support of WVDP environmental monitoring programs are required to participate in the DOE Interlaboratory Quality Assurance Program coordinated by the DOE Environmental Measurements Laboratory.

7.0 REFERENCES

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8.0 ACRONYMS

AEA	Atomic Energy Act
AEC	Atomic Energy Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDDL	Construction and Demolition Debris Landfill
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CPC	Chemical Process Cell
CPC-WSA	Chemical Process Cell Waste Storage Area
CRP	Community Relations Plan
CSS	Cement Solidification System
DCG	Derived Concentration Guide
DOE	(U.S.) Department of Energy
DOE-HQ	Department of Energy Headquarters
DOE-OH	Department of Energy Ohio Field Office
EIS	Environmental Impact Statement
ELAP	Environmental Laboratory Approval Program
EMPP	Environmental Monitoring Program Plan
EPA	(U.S.) Environmental Protection Agency
GIS	Geographic Information System
GMP	Groundwater Monitoring Plan
HLW	High-Level Waste
HLWTF	High-Level Waste Tank Farm
HWSF	Hazardous Waste Storage Facility
IRTS	Integrated Radwaste Treatment System
LIMS	Laboratory Information Management System
LLW	Low-Level Waste
LLWTF	Low-Level Waste Treatment Facility
LPS	Liquid Pretreatment System
LSA	Lag Storage Area
LWTS	Liquid Waste Treatment System
NEPA	National Environmental Policy Act
NDA	NRC-Licensed Disposal Area
NFS	Nuclear Fuel Services, Inc.
NRC	U.S. Nuclear Regulatory Commission
NYARDA	New York Atomic Research and Development Authority
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSERDA	New York State Energy Research and Development Authority
OH/WVDP	Department of Energy, West Valley Demonstration Project
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation

SAP	Sampling and Analysis Plan
SDA	New York State-Licensed Disposal Area
SOP	Standard Operating Procedure
SPDES	(NY) State Pollutant Discharge Elimination System
SSWMU	Super Solid Waste Management Unit
STS	Supernatant Treatment System
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TEGD	Technical Enforcement Guidance Document
TRU	Transuranic Waste
TSDF	Treatment, Storage or Disposal Facility
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WNYNSC	Western New York Nuclear Service Center
WVDP	West Valley Demonstration Project
WVNSCO	West Valley Nuclear Services Co. LLC

APPENDIX A
LIST OF PROCEDURES APPLICABLE TO THE GROUNDWATER MONITORING PROGRAM

EM-1	Sample Identification and Information Flow Management
EM-3	Preparation of Environmental Samples for Gross Alpha, Gross Beta, and Tritium Counting
EM-6	Groundwater Sampling
EM-12	Alpha and Beta Counting
EM-13	Tritium Counting
EM-15	Purifying Sr-90 from Other Beta-Emitting Nuclides
EM-16	pH Measurement
EM-19	Sample Container Selection and Sample Preservation
EM-52	Environmental Sample Receipt, Handling, Storage, Packaging and Shipment
EM-54	Conductivity Measurement of Aqueous Solutions and Daily Check of Laboratory Reagent Water System
EM-55	Measuring pH, Conductivity, Dissolved Oxygen, and Temperature of Field samples
EM-56	Turbidity of Water Samples
EM-67	Organics Data Validation
EM-68	Inorganics Data Validation
EM-69	Isotopic Gamma Counting Using the Genie Data Acquisition System
EM-73	Field Sampling Activity Verification
EM-74	Radioanalytical Data Validation
EM-77	Rapid Determination of Strontium-90 in Water using Empore Strontium Rad Risks
EM-101	Quality Assurance and Quality Control for Environmental Monitoring Services
EM-106	Nonconformances and Corrective Actions
EM-107	Training of Environmental Laboratory Personnel
EM-108	Data Validation
EM-500	Drilling, Soil Sampling, and Geologic Logging Procedures
EM-519	Monitoring Well Development
EM-521	In-Situ Hydraulic Conductivity Testing
EMP-11	Documentation and Reporting of Environmental Monitoring Data
EMP-101	Quality Assurance for the Environmental Monitoring Program
EMP-103	Self Assessments for Environmental Programs
EMP-105	Environmental Monitoring Records Management
EMP-515	Groundwater Monitoring Equipment Inspection Procedure
ENV-002	Decommissioning Groundwater Monitoring Wells

WVNSCO RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	12/13/95
1	Revision to incorporate NYSDEC comments on the CDDL RFI Report	All	09/20/96
2	Revision to incorporate NYSDEC comments on Rev. 0 of the Plan	All	12/11/96
FC1	Added a note to page 21 to refer to WVDP-240 for sampling and analysis of groundwater Seeps	21	02/26/97
	Changed RI frequency to 4/yr for well 301	22	
	Deleted SP008 from Table 3	22	
	Moved asterisk from (BG) to I,RI for well 706	24	
	Deleted "M" from column titled Monitoring Parameters for well 86-03	24	
	Deleted "M-2/yr" from column titled, Monitoring Frequency for well 86-12	24	
	In column titled, Monitoring Well Location, changed SP-18 to SP-23	25	
	Deleted asterisk from Seeps.	25	
	In column titled, Monitoring Well Location, deleted SP-12	25	
	Deleted asterisk from Seeps	25	
	Deleted asterisk from (BG) for 1008B	25	
	Added WP-A, WP-C, WP-H	25	
	Deleted asterisk from 1008B	25	
	Deleted asterisks from column titled, Monitoring Parameters (I, RI) for NB1S	25	
	Deleted wells 203 and 601 from Table 4	29	
FC2	Added a "period" to the end of the last sentence in the first paragraph. Added well 706 to text describing sand and gravel background wells.	10 13	04/02/97
	Deleted second to last paragraph that provides extraneous information about history of some well installations over the history of the project.	14	
	Deleted extra spaces in first paragraph.	16	
	Capitalized the "v" in "Semi-volatile" and changed "gamma emitters" to tritium.	20	
	Deleted the "*" from the indicator parameters "I" because NYSDEC does not require any notification for exceptions of these parameters per Table 4.	21-25	
	Added an "*" to the RI parameter for well 408.	23	
	Included the most current figure of active groundwater monitoring locations.	26	
FC3	Table 2, "R" changed "Tritium" to "Gamma Emitters"	20	08/08/97

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Rev. No.	Description of Changes	Revision On Page(s)	Dated
FC3	Table 2, "SM" added "mercury, silver, and barium"	20	
	Deleted asterisk from well 86-03	24	
3	Revision to incorporate improved technical terminology	All	12/18/98
	Revision to add measurement of surface water elevations concurrently with quarterly ground-water elevation measurements	30	
	Revision to clarify the calculation of trigger limits, including new flowchart	31-34	
	Revision to add trigger limits for groundwater elevation data	35	
	Revision to correct a procedure title	48	
4	Added references to WVDP-298 and WVDP-346	8	11/14/00
	Changed depth of weathering in weathered Lavery till from 3 meters to 5 meters	9	
	Changed wording regarding recharge in the form of precipitation	10	
	Added discussion of vertical groundwater migration in the unweathered Lavery till	10	
	Updated the number of groundwater monitoring locations	14	
	Wording changes regarding selection of locations for groundwater monitoring wells	14	
	Updated the range of monitoring well depths	15	
	Added references to WVDP-298 and WVDP-346	16	
	Added discussion of pilot-scale permeable treatment wall (PTW)	16	
	Wording changes regarding groundwater seepage monitoring	16	
	Wording changes regarding special monitoring parameters	16	
	Added discussion of groundwater monitoring and installation of a bioventing system associated with petroleum-contaminated soils located near the southwest corner of the main warehouse	17	
	Wording changes regarding groundwater program review	18	
	Discussion of elimination of selected seepage monitoring locations	18	
	Wording changes regarding the Cr/Ni Pilot Program	19	
	Discussion of elimination of Cr/Ni sampling at selected groundwater monitoring locations	19	
	Discussion of well corrosion monitoring	19-20	

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Rev. No.	Description of Changes	Revision On Page(s)	Dated
4	Wording change regarding well redevelopment activities	20	
	Updated groundwater monitoring parameters in Table 2	22	
	Updated the list of groundwater monitoring locations and analytes	23-26	
	Wording changes regarding groundwater analytical parameters	29	
	Updated list of locations used for potentiometric measurements in Table 4	30	
	Wording changes regarding synchronous water level measurements	30-31	
	Wording changes regarding groundwater data management	31	
	Wording changes regarding data evaluation and trigger limits including change from GRITS/STAT software to S-Plus and Environmental Stats for S-Plus software	32-33	
	Wording changes regarding trigger levels for groundwater elevation data	35	
	Discussion of groundwater database maintenance and the groundwater geographic information system	36	
	Wording changes in Table 5 regarding groundwater trigger levels	38	
	Added references for S-Plus and Environmental Stats for S-Plus software	42	
	Added references for WVDP-298, WVDP-346, and the final report on the Cr/Ni Pilot Program	43	
	Changed the definition for the "WVNS" acronym	45	
5	Deleted "Dames & Moore" and added "URS"	4	09/27/01
	Changed "Company, Inc." to "Corporation"	4	
	Deleted "that are referred to" and added "geographically"	8	
	Added "in descending order"	9	
	Deleted "that" and added "These two units"	10	
	Changed "RCRA Facility Investigations" to "RFIs"	12	
	Added reference to Table 2	14	
	Deleted well tally; referred to Tables 3 and 4. Add reference to WVDP-190	14	
	Removed "the background seep location"	16	
	Changed "respective" to "the"	19	
	Added "of these wells"	19	
	Added discussion of well screen corrosion monitoring and cleaning	20	

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Rev. No.	Description of Changes	Revision On Page(s)	Dated
5 (Cont.)	Deleted "G" and "K" parameters	22	
	Deleted Note #3	23	
	Removed "WN" from "WNGSEEP"	26	
	Deleted row for well 1109A	26	
	Updated Figure 3	27	
	Updated synchronous water level discussion	30	
	Updated well list in Table 4	30	
	Updated surface water elevation discussion	30	
	Changed "will be" to "are"	31	
	Deleted "evaluation"	31	
	Deleted "Environmental"	40	
	Deleted WVDP-240 from reference list	43	
	Added WVDP-209 and WVDP-214	43	
	Added "GIS" acronym	44	
	Deleted "WVAO"	45	
	Environmental Affairs and URS are affected by these changes.		
6	Changed the cognizant engineer (B. Heim) to D. Klenk	Cover	10/24/03
	Updated procedure format to comply with WVDP-257 DCIPs	throughout	
	Environmental Affairs and URS are affected by these changes.		
7	Replaced references to DOE Order 5400.1 to DOE Order 450.1	4,12,13,40	12/03/03
	Added Section 1.1 on RCRA considerations and renumbered subsequent sections	4,5	
	Updated discussion of EIS process	6	
	Updated Figure 1	7	
	Deleted phrases and sentence referring to DOE Order 5400.1	13,14,29	
	Added discussion of RHWF well installations	15	
	Added sentence on anticipated future monitoring reductions for RHWF wells and designation of new background wells	15	
	Added new RHWF wells to Table 3	24	
	Updated Figure 3	25	
	Environmental Affairs Department personnel are affected by the changes.		

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Rev. No.	Description of Changes	Revision On Page(s)	Dated
8	Added Section 14.1 RCRA Considerations	4	11/03/04
	Updated status of WVDP EISs	6	
	Updated hydraulic position, monitoring parameters, and monitoring frequency for wells 405 and 706	15,23	
	Updated status of biovent system	17,18	
	Updated analytical parameters for off-site wells	18	
	Updated hydraulic conductivity information	20	
	Added SSWMU 2 for Well 204	22	
	Updated date of groundwater trigger limit report	32	
	Updated groundwater trigger limit decision flowchart	33	
	Added Model 556MPS for the YSI water quality monitor	39	
	Environmental Affairs Department personnel are affected by the changes.		
9	Update on Waste Management EIS	6	09/19/05
	Changed “confident” to “groundwater”	13	
	Modified text regarding VOCs at the CDDL	17	
	Updated information on the biovent system	18	
	Changed well inspection frequency from annual to periodic	20	
	Updated monitoring parameters and frequencies in Table 3	22-25	
	Added wells 83-4D and 83-4E to Table 4	29	
	Updated data validation information	31	
	Updated information on database uploads	35	
	Environmental Affairs Department personnel are affected by these changes.		